KANSAS CITY

REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. IV. MAY, 1880. NO. 1.

GEOGRAPHY.

EXPEDITIONS TO THE ARCTIC SEA.

We gladly give place to the following letter from Prof. John Rae, of London, correcting a few errors of statement in a former article on this subject.—[ED.

THE EDITOR OF THE KANSAS CITY REVIEW:—

Sir,—In looking over your REVIEW of March, kindly sent me by a friend, I find a list—chronologically given—of the various national expeditions to the Polar Seas.

In this list there is one entry that was not a National expedition, one error of date, and three omissions, which perhaps you would allow me to point out—

The expedition under Captain (*not Lieutenant*) Back, in 1833, was got up by private subscription, aided by the government to the extent of not a third of the money required.

No expeditions were sent in 1847 by the British government to search for Sir John Franklin.

Sir John Richardson and Dr. Rae were sent by the British government overland in 1848 to the Arctic Sea, *via.* McKenzie River, and searched the coast eastward to the Coppermine River for Franklin. This was a costly expedition, as boats and men were sent from England via. Hudson's Bay.

In 1849 the British government sent Dr. Rae to the Arctic coast, by the Coppermine River, to search for Franklin.

In 1851 Dr. Rae was again employed by the British government to search for Franklin by the Coppermine River, during which a sledge journey of over

XUM

a thousand miles was made at the average rate of about twenty-five miles a day; the fastest time on record, considering that both officer and men were *hauling sledges* or carrying loads all the time. On this journey and the subsequent boat voyage, about seven hundred miles of unknown coast line of Wollaston and Victoria lands were traced, and *Victoria Strait* discovered and named, remarkable for being the channel in which the crews of the Franklin Expedition abandoned their ships in 1848. Rae's boats coming from the South, having reached a point on the west shore of the strait in a higher latitude than that where the ships were left, formed a last link in the Northwest passage.

These three expeditions were wholly paid for by the British government, and therefore should be included in the chronological list referred to.

Yours, &c.,

JOHN RAE.

HONORS TO NORDENSKJOLD.

The Swedish government has resolved to award a national testimonial to the members of the Expedition under Professor Nordenskjold's direction. The testimonial is not intended for the officers and scientists of the Expedition alone, but for all the men who shared in its dangers and discoveries. King Oscar gives to each man a medal bearing on one side the head of the Sovereign with the inscription, "Oscar II, King of Sweden and Norway," and on the other the insignia of the order of the Northern Star, with the legend "For having opened a route in the Glacial Arctic Ocean, 1878–1879." Fifty copies of this medal will be struck off—four of them in gold and the remainder in silver.

Nordenskjold reached Paris April 2, accompanied by Captain Pallander, the sharer of his adventures in the North. They were received at the railway station by delegates of the various scientific societies—M. Grandidier, president, and M. Maunoir, secretary of the Geographical society; M. Siebbern, Swedish Ambassador, with several attachés; M. Rabaud, representing the Societè de Marseilles; M. Meyners d'Estreye, President of the Societè Indo-Chinoise; Dr. Crevaux, the young explorer of French Guiana; a deputation of Swedish residents and a few journalists, including your correspondent Nordenskjold looked the very picture of health and seemed vigorous enough for a dozen Arctic expeditions. He was dressed with the utmost simplicity in a light traveling suit. Captain Pallander appeared to be very much embarrassed in the attire of a private gentleman, being so long accustomed to his naval uniform. M. Grandidier said that he was happy to meet such a distinguished visitor and bade him welcome in the name of the geographical societies of Paris and the Departments and of the scientific societies of France. A banquet was given them on the night of April 4th, by the members of the Swedish Colony in Paris. Upward of two hundred gentlemen and ladies of Swedish nationality were present. But few invitations to foreigners were issued, and these merely to the press. The grand saloon of the Continental Hotel was tastefully arranged for the occasion, one of the decorations being a carved

prow of the Vega, surmounted by a bust of Nordenskjold, by Runeberg, son of the great Swedish poet. This was projected in the center of the hall. On the columns of the room were escutcheons bearing the names of great Swedish explorers of old as well of those who had taken part in the Nordenskjold Expedition. At the central table was seated Prince Oscar, and among the principal persons present were the Swedish Ambassador, the Swedish Consul General Moltke, the Danish Ambassador, the Consul General of Spain, Colonel Staafe, military attaché; Christine Nilsson, the singer, and M. Rouzeaud, her husband. The Swedish Minister proposed Nordenskjold's health, and the explorer replied in Swedish, but with a strong Finnish accent. He modestly said that the greatest pleasure which he derived from his success was that it all redounded to the honor of his country.

On the 5th of April Nordenskjold was formally received by the Municipal Council of Paris, at the Pavillon de Flore, in the Tuilleries. Neat complimentary addresses of welcome having been read by the President of the Council and M. Ferdinand Herold, Prèfet of the Seine, who represented the government, Nordenskjold was then presented with a handsome gold medal commemorative of his expedition and of his visit to Paris. Its value was some $300.00. The explorer acknowledged the compliment in modest phrase, and the ceremony was ended by the President gracefully thanking the French and foreign press for their attendance. The hall was tastefully decorated with flags. The Municipal Guards, in full uniform, lined the staircase.

A NEW POLAR EXPEDITION.

The *Presse*, of Vienna, announces that Capt. Weyprecht, of the Austrian Navy, in concert with Count Wilczek, is completing arrangements for another expedition toward the North Pole at an early date. This time Capt. Weyprecht will not be accompanied by any of the intrepid companions of his former voyages, as it appears they prefer rest at home to the adventures and dangers of the hyperborean seas.

THE NORDENSKJOLD AFLOAT.

The Calcutta *Englishman* reports that the Swedish steamer A. E. Nordenskjold, which was sent out in June last in search of Nordenskjold's Expedition and went ashore two months later on the Japanese island, Jesso, has been got off safely. M. Sibiriakoff, who commanded her, will attempt to return home westward round the north coast of Asia, from Behring's Strait to Spitzbergen, on the route which Nordenskjold took when going eastward in the Vega. [The rescued craft, though small, being 340 tons burden and sixty horse-power, is admirably calculated to resist the rigors of Arctic navigation, a resistance that has been proved by her successful weathering of a severe winter in the inhospitable region of Jesso.] Her small size will be rather an advantage than otherwise in the difficult route M.

XUM

Sibiriakoff has proposed to follow. The Nordenskjold was built at Malmo, Sweden, for the express purpose of going to the assistance of the explorer, whose whereabouts were then unknown. She was launched on April 23, 1879, and left Malta on June 3 for Behring's Strait by way of the Suez Canal. She was to pass through Behring's Strait and thence direct her course to the mouth of the Lena. On August 4 the vessel left Yokohama and proceeded on her way north. At the time the Nordenskjold started it was considered that the Vega was beset in the ice some forty miles northwestward of East Cape at Behring's Strait, and at a considerable distance from any settlement. The Nordenskjold was to seek the missing vessel there. When the fate of Professor Nordenskjold and his expedition were still undecided and grave fears were entertained for his safety, M. Sibiriakoff, a warm friend and supporter of the explorer, was the first to take practical measures for his relief and his steamer was the first fitted out for the purpose, he bearing all the expenses of the expedition. Not content with fitting out a steamer of his own, he made earnest appeals for assistance in all quarters where it was likely to be given.

ASTRONOMY.

A NEW DETERMINATION OF THE DIAMETER OF MARS.

H. S. PRITCHETT, ASTRONOMER MORRISON OBSERVATORY.

During the near approach of the planet Mars, in the recent opposition of 1879, the following careful observations of its diameter were made with the large Equatorial of the Morrison Observatory, partly with the purpose of testing the figure of the apparent disc, and partly to furnish an accurate measure with a filar micrometer for comparison with those obtained from the heliometer. I have just finished a reduction and discussion of these measures, and the results given below represent an abstract of a more complete paper forwarded to the "*Astronomische Nachrichten.*" The observations were made by Prof. C. W. Pritchett.

While the measures of such an object as the disc of Mars with a filar micrometer, will never be entirely free from the effect of irradiation, and therefore will never give the true value of the diameter quite as accurately as the heliometer, still, in a telescope of such good definition as the one used, this effect would be very small. Filar micrometer determinations of the diameter are still further useful from the fact that they are to be used in the reduction of incomplete observations made with similar instruments, and for other common astronomical operations. For this reason the values of the diameters of planets used in computing their apparent discs for the *Nautical Almanac*, *Berliner Yahrbuch* and *American Ephemeris*, are derived from observations with a filar micrometer.

The discrepancy between these and the value obtained from the heliometer is shown in the following table. In the column "Diameter" the angular value of the diameter for distance unity is given:

Value used in the Nautical Almanac and Berliner Yahrbuch,	11″.100
Value used in the American Ephemeris	10.108
Bessel's value from the Heliometer, ...	9.328
Hartwig's value from Heliometer observations of Bessel, Kaiser, Main and himself	9.352

The difference here shown between the largest and smallest values amounted to 4″ at the time of opposition. The value used in the *American Ephemeris* was derived from observations with the Mural Circle (aperture 4.1 in.) of the Naval Observatory during 1845-46, and is subject to the large probable error ±0″.203. In the observations made at this observatory the diameter of the disc was measured in four different directions:

1. From position angle 143° to 323°, corresponding to the polar diameter.
2. From position angle 8° to 188°.
3. From position angle 98° to 278°.
4. From position angle 53° to 233°, corresponding to the equatorial diameter.

The observations extended from October 27 to November 24, the opposition occurring on November 12, and the nearest approach of the planet to the earth on November 4. After correcting the separate observations for incomplete illumination and reducing to distance unity, the results of the measures are shown in the following table:

DIRECTION.	NO. OBSER'TION.	DIAMETER.	PROBABLE ERROR.
143°—323°	17	9″.422	± 0″.024
8°—188°	9	9 .489	± 0 .043
98°—278°	8	9 .517	± 0 .032
53°—233°	17	9 .638	± 0 .044

If these separate results are considered as independent measures of the same diameter, and combined according to the method of least squares, there will result finally, Diameter=9″.486±0″.033, which, combined with Newcomb's value of the solar parallax, gives for a mean value of the diameter of the planet 4248 miles, with a probable error of 15 miles. This value, as will be seen, agrees quite closely with the determinations of the heliometer, and shows conclusively that the values in use in the Ephemerides are much larger than would be given by any good instrument of good definition and moderate size.

The difference between the polar and equatorial diameters being so much greater than the probable error would indicate, seems to show an ellipticity of the apparent disc. This systematic difference was noted in the individual observations from day to day, and is confirmed by the measures of the intermediate diameters. The observations would then assign to the planet the form of an ellipsoid of revolution, with a polar diameter of 4220 miles and an equatorial diameter 4317, the amount of compression being 1-45. Very varying results have been arrived at for the amount of compression of Mars. Sir Wm. Herschel gives it 1-16; Schröeter less than 1-80; Arago, from Paris observations extending over 36

XUM

years, 1-30; Hind gives it 1-51; and Main 1-62. Bessel merely decided that it was too small for measurement with his heliometer. This discordance shows quite clearly the difficulty of measuring such a bright glowing disc as that of the planet Mars.

ENGINEERING.

COMPARATIVE MERITS OF WOOD, STONE AND ASPHALT PAVEMENTS.

GEN. Q. A. GILMORE, U. S. A.

Assuming the foundation to be firm and solid, so that ruts and depressions cannot form upon the surface except from actual wear, a pavement of stone blocks, of first quality as regards hardness and toughness, will possess the longest life of the three, and one of wood blocks the shortest; asphalt lies between the two and very near to the stone, and will fluctuate from this position with the amount and kind of traffic, and the influences of the climate. As a rule wood must be regarded as the least durable. When it begins to go—at the end of two or three years, under heavy traffic—it wears rapidly into deep and numerous ruts, by the crushing of the blocks to their entire depth. Unless the stone be of excellent quality for pavements, it takes the second place in the order of durability, and asphalt the first.

The absolute cost of constructing the different pavements will of course vary very considerably with the locality. It is believed, however that with few exceptions, the following order of cheapness will obtain throughout the United States: viz., first, wooden blocks; second, asphalt, on a solid cobble stone foundation; third, asphalt on a concrete foundation; fourth, stone blocks on a concrete foundation.

Under the head of cost and maintenance of repairs, the life or endurance is to be considered, and the total expense must extend over and cover a period of time representing that endurance, under the assumption that at the end of that period, the pavement is in as good a condition as at the beginning when it was new. The repairs for the first two or three years will be comparatively trifling, and in some cities, more especially in England, it is customary for the constructor to maintain the pavements in a good sound condition without charge for one, two and sometimes three years, and subsequently for a longer period, seldom exceeding fifteen years, for a specified sum per square yard per year.

With regard to wood and asphalt, the recorded observations make it certain that although a pavement of wooden blocks is less costly to construct than one of asphalt, not only is its annual cost for repairs greater, but its mean annual cost during its life, inclusive of the first cost, is also greater than that of asphalt. With

regard to stone, there is a vast difference in the endurance of hard and tough basalt and trap, and the average granite and gneiss.

In economy of maintenance per year during the lifetime of a pavement, including its first cost, the hard basaltic trap rocks should be placed first, asphalt second and wood third, except in localities where wood is very cheap and suitable stone cannot be procured, or is subject to heavy charge for transportation. Under such circumstances stone would take the third place and wood would rise to the first. Where wood and stone are both expensive, or the latter is not of the best quality with respect to toughness, asphalt would take the first position.

Both mud and dust adhere with more tenacity to wood than to asphalt or stone, more especially after the fibers of the former begin to crush and abrade, and the order of merit in respect of facility of cleansing, will be first, asphalt, second, stone, and third, wood, whether the cleansing be done by sweeping or by washing. It stands to reason that a smooth, even surface can be cleansed more rapidly than one cut up with numerous joints.

Mr. William Haywood, C. E., of London, in his report "as to the relative advantages of wood and asphalt for paving purposes," made to the Commissioners of sewers of the city of London, March 17th, 1874, says that "asphalt is the smoothest, dryest, cleanest, most pleasing to the eye, and most agreeable for general purposes, but wood is the most quiet." It might perhaps be better to say that the noise produced by wood is of a different kind, which may be more disagreeable to some persons and less so to others. Stone is the noisiest of all pavements.

The noise produced by wood is a constant rumble, that by asphalt an incessant clicking of the horses' feet upon the street surface, with scarcely any noise from the carriage wheels, while stone gives out a deafening din and rattle from feet and vehicle combined.

On the supposition that the surface is kept clean by either sweeping or washing, the difference in slipperiness between wood, stone that does not polish under wear, and asphalt, is not great, although enough, perhaps to place asphalt last; while a horse not only falls more frequently, but recovers himself less often and less easily upon it than upon the others, by reason of the joints in the latter, which give a foothold. When the surface is covered with mud, asphalt is the most slippery of the three, and very little mud makes it slippery. It cannot be said to be slippery when very dry, or, if free from mud, when very wet.

In times of snow there appears to be little if any difference in this respect between wood, asphalt and stone, but under a sharp dry frost, asphalt and stone are generally quite dry and safe, while wood retains moisture and is very slippery.

In the condition in which they are usually maintained, a slight rain adds to the slipperiness of each of these pavements, with this difference, that on asphalt and stone this state begins with the rain or very soon thereafter, while the worst condition of wood ensues later. It however lasts longer than upon the others on account of its absorbent nature. With regard, therefore, to the convenience and comfort of those using the street, as well as those living adjacent thereto, the

XUM

weight of opinion appears to place asphalt first, wood second and stone third, for all streets except those habitually crowded with heavy traffic, in which case stone would rise to the first place and asphalt drop to the third.

A practical and general recognition of the fact—so well known in the medical profession, and indeed among all ranks of cultured people—that the pavements of a city exert a direct and powerful influence upon the health of its inhabitants, has never been secured. Most people claim simply that a street surface should be hard and smooth without being slippery, and, as a measure of economy, that it shall be durable and easily cleansed; but they go no further.

The advantages of noiselessness are recognized by many upon various grounds; by the large majority as simply conducive to comfort, but by few as conducive to health; while the kind of material used, provided it satisfies the foregoing conditions, and the character of the surface is satisfactory with regard to continuity and impermeability, is far too generally considered to be a matter of small moment.

The hygienic objections to granite, are first, its constant noise and din, and second its open joints which collect and retain the surface liquids, and throw off noxious vapors and filthy dust.

Dr. A. McLane Hamilton, Assistant Sanitary Inspector of the city of New York, in an official report dated October 19, 1874, says, "a quiet and noiseless street pavement would advance the health of the population to a great extent. The sufferer from nervous diseases would find relief from the noise of empty omnibuses and wagons rumbling or rattling on the rough stones, in the event of a removal of this nuisance. In fact there would be many more sanitary benefits resulting from a change than I can here detail."

It is not deemed necessary to enlarge further upon this point. The writings of eminent medical practitioners are full of testimony to the pernicious influence of street noise and din upon the health of the population, particularly upon invalids and persons with sensitive nerves.

The noisome and noxious exhalations emanating from the putrescent matter, such as horse dung and urine, collected and held in the joints of stone pavements, constitutes another sanitary objection to their use in populous towns. Exceptions to wood may be taken upon the same, and even upon stronger grounds, for the material itself undergoes inevitable, and, sometimes, even early and rapid decay, in the process of which the poisonous gases resulting from vegetable decomposition are thrown off.

The joints of a block pavement, whether of wood or stone, constitute, after enlargement by wear, fully one-third of its area, and under the average care, the surface of filth exposed to evaporation, covers fully three-fourths of the entire street. This foul organic matter, composed largely of the urine and excrement of different animals, is retained in the joints, ruts and gutters, where it undergoes putrefactive fermentation in warm, damp weather, and becomes the fruitful source of noxious effluvium. In dry weather this street soil floats in the atmosphere and penetrates the dwellings in the form of unwholesome dust, irritating to the eyes

and poisonous to the organs of respiration. Its damage to furniture, though serious, is unimportant in this connection. In the side gutters and underlying soil the foul matter exists in a more concentrated form, the supply being constantly renewed from the crown of the street, and in many districts, from the filthy surface drainage of backways and alleys peopled by the poorer classes. Is it too much to say that under such circumstances the infant population, and especially the children of poor people, in large towns, can only be reared under such predispositions to disease as will constitutionally render them an easy prey to epidemics in maturer years?

The foregoing are some of the leading hygienic objections to pavements laid in blocks, whether of stone, wood or other material. There are others peculiar to wood alone, arising from its decay, its natural porosity, and the spongy character conferred upon it by wear and crushing.

"Impregnation of wood with mineral matters, to preserve it from decay, may diminish these evils, but nothing as yet tried prevents the fibers being separated, and the absorption of dung and putrescent matter by the wood being continued. The condition of absorbing mere moisture is of itself bad, but when the surface absorbs and retains putrescent matters it is highly noxious. The blocks of pavement with this material are separated by concussion, and are thus rendered permeable to the surface moisture. Mr. Sharp, who examined some blocks taken up for re-pavement, states that he found them perfectly stained and saturated with wet and urine at the lower portions, while the upper portions were dry. Mr. Elliott, a member of the society, and for many years a deputy of the Common Council of the city of London, has carefully observed the trials of new modes of pavement there, and objects to wood that it is continuously wet and damp. Wood is wet or damp, more or less, except during continued very dry weather. Its structure is admirably adapted to receive and hold, and then give off in evaporation, very foul matters, which taint the atmosphere and so far injure health." (Report of P. Le Neve Foster, Secretary Society for the Encouragement of Arts, Manufactures and Commerce: London, 1873.

Prof. Fonssagrives, of France, says: "The hygienist cannot, moreover, look favorably upon a street covering consisting of a porous substance capable of absorbing organic matter, and by its own decomposition giving rise to noxious miasma, which, proceeding from so large a surface, cannot be regarded as insignificant. I am convinced that a city with a damp climate, paved entirely with wood, would become a city of marsh fevers."

The dust produced by the abrasion and wear of a wooden pavement is regarded by physicians as extremely irritating to the organs of respiration and to the eyes, and being light in weight it floats longer in the atmosphere and is carried to a greater distance, than that from any other suitable material in use for street pavements.

The evidence from a sanitarian point of view, against the use of wood for paving purposes in populous towns, is very strong, but the evils are not developed to the same extent in all localities. Decomposition begins in two or three years

in clayey and retentive soils, while it is very considerably retarded and the wood remains habitually drier and emits less effluvia where the subsoil is sandy and porous.

The most characteristic features and properties of asphalt pavements have been briefly summarized and it is not deemed necessary to repeat or enlarge upon them here. Professor Fonssagrives remarks that, "The absence of dust, the abatement of noise, the omission of joints – permitting a complete impermeability and thus preventing the putrid infection of the subsoil—are among the precious benefits realized by asphalt streets."

Upon hygienic grounds, therefore, asphalt conspicuously stands first, stone second, and wood third in order of merit.

The correct inference from the foregoing discussion is that no one pavement combines all the qualities most desirable in a street surface. It cannot be sufficiently rough, or sufficiently soft, to give the animals a secure foothold, and at the same time possess that smoothness and hardness which is so essential to easy draught. The advantages of open joints and entire freedom from street filth cannot exist together, under any reasonably cheap method of cleansing the surface.

A pavement of impermeable blocks, if laid upon a solid foundation, may be constructed and maintained in a water tight condition, by thoroughly caulking the joints with suitable material, leaving the surface sufficiently rough and open to obviate the objection to a continuous monolithic covering, but roughness, combined with the requisite hardness, is incompatible with the freedom from noise attainable with some kinds of acceptable street surface.

In order, therefore, to obtain the best pavement for any given locality a judicious balancing of characteristic merits is generally necessary. The best pavement so far as we now know, for all the busiest streets of a populous city, where the traffic is dense, heavy and crowded, is one of rectangular stone blocks set on a foundation as good as concrete, or as rubble stone filled in with concrete; and the next best is one of Belgian blocks set in the same manner.

The best pavement for streets of ample width, upon which the daily traffic is not crowded, or for streets largely devoted to light traffic or pleasure driving, or lined on either side with residences, is continuous asphalt for all grades not steeper than 1 in 48 or 50.

If the blocks of compressed asphalt fulfill their present promise, they may be able to replace those of stone upon streets where the latter are now preferable to a sheet of asphalt on account of the steepness of the grade.

It has been urged, as an objection to a concrete foundation, that it is difficult to take up in order to reach the gas and water pipes. This is true only in the sense that good work is not easily taken to pieces. But such a foundation when torn up or deranged from any cause, can readily be restored to its former condition, and the pavement relaid upon it with all its original smoothness, firmness, and stability, conditions which do not obtain with any kind of pavement laid upon a bed of sand or gravel.—*Roads, Streets and Pavements.*

REMOVAL OF CLEOPATRA'S NEEDLE FROM EGYPT TO NEW YORK.

Through the skill of Lieutenant Commander Gorringe, of the United States Navy, backed by the splendid liberality of one of New York's citizens, Mr. W. H. Vanderbilt, who has borne the entire expense of the undertaking, the remaining "Cleopatra's Needle," which was presented some time ago by the Khedive of Egypt to the United States, has been finally safely lowered from its pedestal to the ground; and if no unforeseen accident should occur, may be expected to reach our shores in the early part of the coming summer.

Obelisks are the most simple monuments of Egyptian architecture, and among the most interesting that antiquity has transmitted to us, from the remoteness of their origin, and the doubt in which we still remain as to the period when set up. The oldest which now remains to us is still standing at Heliopolis, near Cairo—the On Ramses or Beth-Shemesh of the Hebrew Scriptures. Abraham was unborn, and the Pentateuch of Moses was unwritten when the inhabitant of Heliopolis adored his gods in the Temple of the Sun and read upon the obelisk, still in its place, the name of Harmachis and that of King Osortisen, who then reigned and reared it, and to whom Mariette Bey assigns the date of 2,851 years B. C. Pliny says that the Egyptian term for an obelisk conveyed the idea of a sun's ray, which its form was supposed to symbolize. The term obelisk is derived from the Greek *obelos*, which meant a "spit"—a term which the witty epigrammatics gave them, with the view, like all wits in such cases, to cover with an air of ridicule what they could not controvert by reason. Obelisks have, from the earliest periods of antiquity, been regarded as remarkable monuments of the skill and perseverance of remote ages. They must ever be considered as valuable records of the ancient history of the Egyptians, and of the skill of those periods; monumental evidences of their sovereigns and their warlike exploits. Extracted with vast labor from their quarries as monoliths, conveyed six or seven hundreds of miles down the Nile and erected with difficulty in front of their temples by kings to commemorate their victories and record their various names and titles, they are emblems of both the perseverance and love of glory of the Egyptians and their rulers. The very fact of their being transported to Europe by the ancient Romans under their emperors shows the high value in which they were held by that people, as witnesses of their own world-wide victories in remote regions.

The Egyptians set great value upon the size of their monoliths, and if a large block was extracted from a quarry not quite corresponding in all its sides, whether as to size or form, they would without scruple use it for their immediate purpose, or shape it as near as possible to the object they had in view, without diminishing its size. The consequence is that many of thir obelisks, pedestals, and sarcophagi, where one would have supposed the most scrupulous attention to uniformity would have existed, are irregular in shape. The sides of an obelisk rarely corresponded

exactly with the breadth of its face, or the height of the shaft to any fixed relation with the width at the base; and there is a like disregard in the height of the pyramidion (the pyramid-like apex), which, however, was high-peaked and never stunted. Nevertheless we may assume that the shaft varied from eight to nine diameters high up to the pyramidion, which itself was from sixty to seventy-five hundredths of the breadth at the base. The four sides or faces of the obelisk were usually square, but occasionally they were convex; a fact proving the nice perception for effect which prevailed in the minds of the Egyptians, as thus the light was much softer upon the surface, the shades less crude, and the angles less cutting. Some of the huge blocks intended for obelisks came from the quarry misshapen at the smaller end, and to remedy such a defect they covered it with a metal capping of the required shape rather than reduce its length by cutting off the rugged portion. The summit of the Luxor obelisk, now in Paris, was irregular in shape and quite rough, and must originally have been capped with metal. Usually, obelisks had one, two, or three vertical hieroglyphs. It may be assumed that only one series was intended by the original Pharaoh; but it appears that his son, successor, or successors, added a line on each side; and it is remarkable that earlier hieroglyphs were much deeper cut than the more recent ones. Mariette Bey, the Egyptologist, mentions the fact that the faces of obelisks were sometimes gilded, the hieroglyphs themselves retaining their original color and actual surface of the granite. On the subject of the dies, pedestals, and steps upon which the monoliths were anciently raised we have little information, for the bottom portions of those now left standing are encumbered and surrounded by huge fallen blocks of stone, preventing their full size from being seen.

All of the large monoliths were of pink granite taken from the quarries of Syene. The position of these quarries must have been of the utmost importance in facilitating the application of that fine material. Situated below the cataracts, when once the masses were extracted from their beds, no obstruction presented itself in their course down the river to their destination, whether to Memphis, Heliopolis, or the delta. Twenty-seven of the forty-two obelisks now known were from Syene, and they are doubtless the largest. An unextracted block still remains at Syene, 95 feet long by 11 feet in diameter, with the quarrymen's marks on it. Sir Gardner Wilkinson states that the final operation of extraction, when three sides of a mass had been worked around, was by cutting a groove or channel about a couple of inches in depth, and kindling a fire along its whole extent. When the stone was intensely heated, cold water was poured into the groove, and the block detached itself with a clear fracture. Wedges of wood were also inserted, saturated with water, then exposed to heat, and the expansion rent the mass asunder. Thus detached it was drawn down to the river, where it was incased, or upon a galley or raft floated down the Nile to near the spot where it was ultimately to be set up. From the river bank it was then hauled up to the Propylea in front of which it was to stand. There are no hieroglyphics or paintings extant to show us how the obelisk was raised and placed in its final position. That this was a

most critical operation is obvious, and its difficulty is illustrated by an anecdote related by Pliny: Rameses erected one obelisk 140 cubits high and of prodigious thickness. It is said 12,000 men were employed on the work. To insure the safety of the operation by the extremest skill of the architect, he had his own son fastened to the summit while it was raised.

As to the tools used in carving the granite we know nothing. Hardly any iron tools have been preserved among the relics of the tombs. With what material did the Egyptians sculpture with such refined delicacy and exquisite sharpness the mouth, eyes, ears, and other features of their statues, and the sharp contours of their hieroglyphs? We are possessed of no process by which brass may be sufficiently hardened for the purpose. Could they have softened the surface by some chemical operation on the harder elements of the stones? No one has as yet been able to inform us, and the secret mystery of the execution of the Egyptian sculpture still excites our wonder and admiration.

The positions of obelisks were before the gigantic pylons which formed the entrance gateways to the fore courts of their temples, and they were without exception always in pairs. At Karnac the situation of the two lofty ones erected by Queen Hatsou (one of which still stands, and is 108 feet 6 inches high, the tallest known) was between two lofty pylons only forty to fifty feet apart. Those in front of the outer pylon are not so distant in advance of it. Consequently the Egyptians disregarded the immediate proximity of a high wall backing them up, and none are known situated in wide open spaces. The sacred way led up from the river, flanked on each side with variously headed sphinxes. At Karnac the dromos is one mile and one-third long, with a line of sphinxes on each side. Approaching nearer, the worshipper finds two obelisks on the right and left, not necessarily of the same height. At Luxor one is seven or eight feet higher than the other, and to diminish the disparity in size, the shorter one is raised on a lofty pedestal and brought some feet in advance of its companion. Attached to the face of the pylon are six gigantic sitting statues of kings, majestic in size, and seated in the hieratic posture. The pylon itself, perhaps 200 feet wide and 100 feet high, forms the background of the whole, crowned by its cavetto cornice, and its surface covered with the colored sculptures of the victorious Rameses in his chariot, with upraised arm, slaying his enemies, trampling them under his horses' hoofs, and alone dispersing them in flight. In the center of the structure is the portal, 56 feet high, through which the sacred or triumphal procession passe all its gorgeousness to within the sacred precincts, there to observe the ritual ceremonies of the mysterious Egyptian cult of one or more of their eight great divinities or animal gods. Erasmus Wilson, in his book entitled "Cleopatra's Needle" (p. 178), enumerates the existing obelisks as follows: Rome, 12; Italy, in addition, 4; Egypt, 6; Constantinople, 2; France, 2; England, 6; Germany, 1.

For nearly 2,000 years there have stood on the shores of the Levant, near Alexandria, two obelisks of rose-colored granite known as "Cleopatra's Needles." We are told by Egyptologists that they were taken from the quarries at

Syene, and thence conveyed to Heliopolis, where by Sesostris they were set up before the entrance to the temple of the god Tum, or the Setting Sun. Pliny states that they were transported to the Nile with the aid of flat-bottomed boats, floating in canals specially prepared for that purpose. Sharpe says that they were placed in an erect position by cutting a groove in the pedestal, in which the lower edge of the monolith might turn as if it were a hinge, the top of the shaft being elevated by means of a mound of earth, the size of which was continually increased till the stone stood securely erect. The obelisks were brought to Alexandria during the reign of Tiberius, but bear their present popular name because of a tradition that they were taken to Alexandria in the time of Cleopatra. Their age is estimated to be about 3,300 years. One of the obelisks has until recently been standing where it was originally placed when brought to Alexandria, but the other, which is the less perfect of the two, has for many years been lying prostrate on the sand. In 1819, Mehemet Ali offered the fallen monolith to the Prince Regent of England, and the British Government accepted the gift, but afterward declined to act in the matter because of the expense attending removal. In 1851, the subject was again brought up; but, as before, no action was taken. Finally, in 1876, Dr. Erasmus Wilson concluded to pay the expenses himself of transporting the great monolith, and bargained with Mr. John Dixon, a well-known engineer and contractor, to bring it to England and erect it on the Thames Embankment for $50.000. Both of these "Needles"—the one transported to England, and its more perfect companion recently presented to the United States by the Khedive of Egypt—possess great historical value, aside from that sentimental estimation which enlightened nations place upon all monuments of antiquity. As far as known the hieroglyphs on the obelisk which is coming to this country have never been deciphered, but as both obelisks are of the same age, and came originally from the same city and temple, it is not unlikely that the inscriptions refer to the same, or, at least, to similar subjects. When the London obelisk was unearthed, it was found to be just 68 feet long, and its weight about two hundred tons. The hieroglyphics which covered each of its four faces were washed, and then deciphered by Brugsch Bey, the eminent Egyptologist. He found that they referred to the lives of the two Kings, Thothmes III. and Rameses II. Subsequently a correct translation of the whole has been made by Dr. Samuel Birch, of the British museum, and is as follows:

"First Side, Central Line, toward east when erected on Embankment.—The Horus, lord of the upper and lower country, the powerful bull; crowned in Uas or Thebes, the King of the North and South Ramen Cheper has made his monument to his father, Haremachu (Horus in the horizons), he has set up to him two great obelisks, capped with gold, at the first time of the festivals of thirty years, according to his wish he did it the son of the Sun Thothmes (III.) type of types did it beloved of Haremachu (Horus of the horizons) ever living.

"First Side—Left Line.—The Horus of the upper and lower country, the powerful bull, beloved of the Sun, the King of Upper and Lower Egypt, Ra-user-ma,

approved of the Sun, lord of the festivals, like Ptah-Tanen, son of the Sun, Rameses beloved of Amen, a strong bull, like the son of Nu (Osiris), whom none can withstand, the lord of the two countries, Ra-user-ma, approved of the Sun, son of the Sun, Ramessu (II.), beloved of Amen, giver of life, like the Sun.

"First Side—Right Line.—The Horus of the upper and lower country, the powerful bull, son of Tum, King of the South and North, lord of diadems, guardian of Egypt, chastiser of foreign countries, son of the Sun Ramessu (II.), beloved of Amen, dragging the South to the Mediterranean Sea, the North to the Poles of Heaven, lord of the two countries, Ra-user-ma, approved of the Sun, son of the Sun Ramessu (II.), giver of life, like the Sun.

"Second Side—Central Line, toward river (south), as erected on Embankment.—The Horus of the upper and lower country, the powerful bull, crowned by Truth, the King of the North and South, Cheper. The lord of the gods has multiplied to him festivals on the great Persea tree in the midst of the place of the Phœnix (Heliopolis). He is recognized as his son, a divine chief, his limbs come forth daily as he wishes, the son of the Sun Thothmes (III.), ruler of An (Heliopolis), beloved of Haremachu (Horus in horizons).

"Second Side—Left Line.—The Horus of the Upper and Lower country, the powerful bull, beloved of Truth, King of the North and South Ra-user-ma, approved of the Sun, born of the gods, holding the two lands (of Egypt), as the son of the Sun, Ramessu (II.), beloved of Amen, making his frontier wherever he wished, who is at rest through his power, the lord of the two countries, Ra-user-ma, approved of the Sun, Ramessu beloved of Amen, the luster of the Sun.

"Second Side—Right Line.—The Horus of the upper and lower country, the powerful bull, son of the god Chepera, the King of the North and South, Ra-user-ma, approved of the Sun. The golden trait, rich in years, the most powerful, the eyes of mankind behold what he has done, nothing has been said in opposition to the lord of the two countries. Ra-user-ma approved of the Sun, the son of the Sun, Ramessu (II.), beloved of Amen, giver of life, like the Sun.

"Third Side—Central Line, west side as erected on Embankment.—The Horus, lord of the upper and lower country, the powerful bull, beloved of Truth, the King of the South and North Ramen Cheper, his father Tum has set up to him his great name, placing it in the temple belonging to An (Heliopolis), giving him the throne of Seb, the dignity of Cheper, the son of the Sun, Thothmes (III.), good and true, beloved of the Spirits of An (Heliopolis), ever living.

"Third Side—Right Line.—The Horus of the upper and lower country, the powerful bull, well beloved of Ra, the King of the South and North Ra-urser-ma, approved of the Sun, lord of festivals of thirty years, like his father Ptah, son of the Sun, Ramessu (II.), beloved of men, son of Tum, beloved of his loins; Athor, the goddess, directing the two countries, has given him birth, the lord of the two countries, Ra-user-ma, approved of the Sun, the son of the Sun, Ramessu, (II.), beloved of men, giver of life, like the Sun.

"Third Side—Left Line.—The Horus, lord of the two countries, the power-

XUM

ful bull, son of the Shu, the King of the South and North, Ra-user-ma, approved of the Ra, the lord of diadems, director of Egypt, chastiser of foreign lands, son of the Sun, Ramessu (II.), beloved of Amen, bringing his offering daily in the house of his father Tum, not has been done as he did in the house of his father, the lord of the two countries, Ra-user-ma, approved of the Sun, the son of the Sun, Ramessu (II.), beloved of Amen, giver of life, like the Sun.

"Fourth Side—Central Line, toward Road (north), as erected on Embankment.—The Horus of the upper and lower country, beloved of the god of the tall, upper crown, the King of the South and North, Ramen Cheper, making offerings, beloved of the gods, supplying the altar of the Spirits of An (Heliopolis), welcoming their persons at the two times of the year, that he might repose through them with a sound life of hundreds of thousands of years with very numerous festivals of thirty years, the son of the Sun Thothmes (III.), the divine ruler, beloved of Haremachu (Horus of the horizons), ever living.

"Fourth Side—Right Side.—The Horus, lord of the upper and lower country, the powerful bull, beloved of Ra, the King of the South and North, Ra-user-ma, approved of the Sun, the Sun born of the gods, holding the countries, the son of the Sun Ramessu (II.), beloved of Amen, the strong hand, the powerful victor, bull of rulers, king of kings, lord of the two countries, Ra-user-ma, approved of the Sun, son of the Sun, Ramessu (II.), beloved of Amen, beloved of Tum, lord of An (Heliopolis), giver of life.

"Fourth Side—Left Line.—The Horns, the powerful bull, son of Ptah-Tanen, lord of the upper and lower country, the King of the South and North, Ra-user-ma, approved of the Sun, the hawk of gold, rich in years, the greatest of victors, the son of the Sun Ramessu (II.), beloved of Amen, leading captive the Rutennu (Syrians) and Petit (Libyans) out of their countries to the seat of the house of his father, lord of the two countries, Ra-user-ma, approved of the Sun, son of the Sun, Ramessu (II.), beloved of Amen, beloved of Shu, the great god, like the Sun.

"The scenes on the pyramidion represent the monarch Thothmes III., under the form of a sphinx, with hands offering to the Gods Ra and Atum, the two principal deities of Heliopolis. The offerings are water, wine, milk, and incense. The inscriptions are the names and titles of the deities, the title of Thothmes III., and the announcement of each of his special gifts.

As before stated, the obelisk which is coming to this country is the more perfect of the two, and is the one usually referred to in the books as *the* "Cleopatra's Needle." The fact that the Khedive should have presented this noble monument to America has excited considerable ill-natured comment in England, and has been regarded with considerable jealousy. The temple at Heliopolis, where these two monoliths originally stood, is of interest to biblical students, as it is supposed to be one in which Moses became learned in all the wisdom of Egypt. When the inscription on our "Needle" shall have been deciphered, further light may be shed upon the history of the remote past in Egypt, which is so profoundly

connected with the whole rise and progress of the religions, the philosophies, and the arts of our own race and our own times.

The method of lowering and transporting the obelisk to this country is entirely original with Lieutenant Commander Gorringe, who has been intrusted with the entire matter. The gigantic framework to be used in lowering the monolith was shipped for Liverpool, October 7th, 1879, on board the Guion steamer Nevada.

From Liverpool it was transhipped to Alexandria, where it arrived safely, and the work of erection immediately began. The machinery was constructed at the works of Messrs. Roebling's Sons Company, at Trenton, after plans made by Lieutenant Commander Gorringe, its total weight being 128,000 pounds. The first operation after arriving at Alexandria was, after erecting the proper scaffolding, to incase the monolith with 2-inch oak planking, bound at intervals of 3 feet with strong iron bands. Then the obelisk was guyed at the top from four points, like the mast of a vessel, so that there could be no possibility of its falling over. The center of gravity had been calculated at a point of twenty-six feet above the base, and here trunnions were placed on either side and bolted across the sides by eight 1¾-inch iron and four 2-inch steel bolts. The trunnions were cast from cannon metal only, and that of the best quality. The trunnion plates were four inches thick, nine feet wide, and six feet high. At the center was the turned trunnion, 33 inches long, and 18 inches in diameter. The weight of each trunnion and plate was 1,250 pounds, making together 1¼ tons. The next operation was to quarry out four 6-inch channel ways through the base of the obelisk, and insert I beams to assist in raising the foundations. Next the foundations were constructed. These consisted of two platforms, one on each side, of 3-inch oak planking, each 6 feet wide and 24 feet long. On top of these were set four oak sticks, 12 by 18, firmly bolted together. The iron work of the towers was then built on top of the preliminary foundation. Each tower was constructed of six 12-inch heavy wrought iron I beams, spreading out at the base to a distance of 21 feet, and converging at the top to within 5 feet. The beams at their base rested on four heavy I beams, and were securely riveted to the platform by means of plates and knees. Placed on top of these posts were caps, each five feet long and thirty inches wide, which also were secured by means of plates and knees. The posts were braced from top to bottom by angle and channnel irons, making the towers perfectly rigid. Placed on top of the caps, and securely bolted to the tower proper, were cast iron journals weighing 3,700 pounds, each forming the grooves for the trunnions to work in. A 6-inch rib had been cast in the bottom of each of the trunnions, and in these ribs were four 2-inch holes. Through each of these holes 1¾-inch iron rods were inserted, connected with similar from the 6-inch I beams running through the base, by means of right and left thread turn buckles, which were used to raise the obelisk from its foundation and throw the weight on the trunnions. On the 6th of December, everything being ready, the monolith was successfully raised in the presence of

XUM

ful bull, son of the Shu, the King of the South and North, Ra-user-ma, approved of the Ra, the lord of diadems, director of Egypt, chastiser of foreign lands, son of the Sun, Ramessu (II.), beloved of Amen, bringing his offering daily in the house of his father Tum, not has been done as he did in the house of his father, the lord of the two countries, Ra-user-ma, approved of the Sun, the son of the Sun, Ramessu (II.), beloved of Amen, giver of life, like the Sun.

"Fourth Side—Central Line, toward Road (north), as erected on Embankment.—The Horus of the upper and lower country, beloved of the god of the tall, upper crown, the King of the South and North, Ramen Cheper, making offerings, beloved of the gods, supplying the altar of the Spirits of An (Heliopolis), welcoming their persons at the two times of the year, that he might repose through them with a sound life of hundreds of thousands of years with very numerous festivals of thirty years, the son of the Sun Thothmes (III.), the divine ruler, beloved of Haremachu (Horus of the horizons), ever living.

"Fourth Side—Right Side.—The Horus, lord of the upper and lower country, the powerful bull, beloved of Ra, the King of the South and North, Ra-user-ma, approved of the Sun, the Sun born of the gods, holding the countries, the son of the Sun Ramessu (II.), beloved of Amen, the strong hand, the powerful victor, bull of rulers, king of kings, lord of the two countries, Ra-user-ma, approved of the Sun, son of the Sun, Ramessu (II.), beloved of Amen, beloved of Tum, lord of An (Heliopolis), giver of life.

"Fourth Side—Left Line.—The Horns, the powerful bull, son of Ptah-Tanen, lord of the upper and lower country, the King of the South and North, Ra-user-ma, approved of the Sun, the hawk of gold, rich in years, the greatest of victors, the son of the Sun Ramessu (II.), beloved of Amen, leading captive the Rutennu (Syrians) and Petit (Libyans) out of their countries to the seat of the house of his father, lord of the two countries, Ra-user-ma, approved of the Sun, son of the Sun, Ramessu (II.), beloved of Amen, beloved of Shu, the great god, like the Sun.

"The scenes on the pyramidion represent the monarch Thothmes III., under the form of a sphinx, with hands offering to the Gods Ra and Atum, the two principal deities of Heliopolis. The offerings are water, wine, milk, and incense. The inscriptions are the names and titles of the deities, the title of Thothmes III., and the announcement of each of his special gifts.

As before stated, the obelisk which is coming to this country is the more perfect of the two, and is the one usually referred to in the books as *the* "Cleopatra's Needle." The fact that the Khedive should have presented this noble monument to America has excited considerable ill-natured comment in England, and has been regarded with considerable jealousy. The temple at Heliopolis, where these two monoliths originally stood, is of interest to biblical students, as it is supposed to be one in which Moses became learned in all the wisdom of Egypt. When the inscription on our "Needle" shall have been deciphered, further light may be shed upon the history of the remote past in Egypt, which is so profoundly

connected with the whole rise and progress of the religions, the philosophies, and the arts of our own race and our own times.

The method of lowering and transporting the obelisk to this country is entirely original with Lieutenant Commander Gorringe, who has been intrusted with the entire matter. The gigantic framework to be used in lowering the monolith was shipped for Liverpool, October 7th, 1879, on board the Guion steamer Nevada.

From Liverpool it was transhipped to Alexandria, where it arrived safely, and the work of erection immediately began. The machinery was constructed at the works of Messrs. Roebling's Sons Company, at Trenton, after plans made by Lieutenant Commander Gorringe, its total weight being 128,000 pounds. The first operation after arriving at Alexandria was, after erecting the proper scaffolding, to incase the monolith with 2-inch oak planking, bound at intervals of 3 feet with strong iron bands. Then the obelisk was guyed at the top from four points, like the mast of a vessel, so that there could be no possibility of its falling over. The center of gravity had been calculated at a point of twenty-six feet above the base, and here trunnions were placed on either side and bolted across the sides by eight 1¾-inch iron and four 2-inch steel bolts. The trunnions were cast from cannon metal only, and that of the best quality. The trunnion plates were four inches thick, nine feet wide, and six feet high. At the center was the turned trunnion, 33 inches long, and 18 inches in diameter. The weight of each trunnion and plate was 1,250 pounds, making together 1¼ tons. The next operation was to quarry out four 6-inch channel ways through the base of the obelisk, and insert I beams to assist in raising the foundations. Next the foundations were constructed. These consisted of two platforms, one on each side, of 3-inch oak planking, each 6 feet wide and 24 feet long. On top of these were set four oak sticks, 12 by 18, firmly bolted together. The iron work of the towers was then built on top of the preliminary foundation. Each tower was constructed of six 12-inch heavy wrought iron I beams, spreading out at the base to a distance of 21 feet, and converging at the top to within 5 feet. The beams at their base rested on four heavy I beams, and were securely riveted to the platform by means of plates and knees. Placed on top of these posts were caps, each five feet long and thirty inches wide, which also were secured by means of plates and knees. The posts were braced from top to bottom by angle and channnel irons, making the towers perfectly rigid. Placed on top of the caps, and securely bolted to the tower proper, were cast iron journals weighing 3,700 pounds, each forming the grooves for the trunnions to work in. A 6-inch rib had been cast in the bottom of each of the trunnions, and in these ribs were four 2-inch holes. Through each of these holes 1¾-inch iron rods were inserted, connected with similar from the 6-inch I beams running through the base, by means of right and left thread turn buckles, which were used to raise the obelisk from its foundation and throw the weight on the trunnions. On the 6th of December, everything being ready, the monolith was successfully raised in the presence of

5,000 people who had come to witness the operation; the foundation was then removed, and the obelisk left hanging free. The obelisk having been turned over to a horizontal position, Captain Gorringe next proceeded to build two piles of beams placed crosswise; and, as soon as they reached the height of the stone, jacks were used to lift the latter out of its trunnion bearings and block it up. All the construction was then removed, and, foot by foot, the obelisk was lowered to the ground by reducing the piles, first from one side and then the other. On the ground the obelisk was incased in an iron cradle, consisting of a parabolic truss on each side, connected by means of heavy channel flow beams and braces. To the flow beams two heavy channel bars were riveted, and corresponding channels were laid on the ground to form the track for the obelisk to move on, the movement being effected by inserting 8-inch cannon balls into the grooves formed by the channel bars, and the track being laid sixty feet ahead of the cradles, so that as the stone was pushed along, the track behind was taken up and placed in front. From the base of the obelisk to the sea a trench had been dug, which, at the end near the sea, is 95 feet long by 40 feet broad, and 16 feet deep; in this portion a float, constructed for the purpose, will be used to transport the obelisk to the port of Alexandria, a distance of about a mile in a straight line. In digging the pit around the base of the monolith, Captain Gorringe discovered that the shaft stood on a pedestal, the existence of which was before unknown. It was 9 feet square, 7 feet in height, and rested upon three well-preserved marble steps with a base of masonry. From the lower surface of the lower step the obelisk rises 81 feet 2½ inches to its summit, and its estimated weight is about 196 tons. At the port of Alexandria the obelisk will be placed on a large ship selected for the purpose, and so brought to this country. [This plan is very different from that adopted by the English engineer, which, it will be remembered, was to inclose the obelisk in a cylindrical vessel formed of wrought iron plates, and provided with water-tight compartments. This, after being rolled into the sea, and towed to the harbor, was ballasted and provided with a keel, deck, sail, and rudder. The vessel was then placed in charge of two or three skilled mariners, for whom a small cabin on deck was provided, and towed to England by a steam tug, the sail being simply for steadying the cylinder.] Should our obelisk reach port in safety the same machinery, with very slight modification, will be used to place it in an erect position, after a proper site has been selected for it.

There can be no doubt that our citizens, as they pass by this obelisk after its erection, will have their curiosity excited by the sight of hieroglyphs which have probably been seen and read by the Jews at the time of Moses, or when the Savior was taken by his parents to Egypt as a place of refuge from Herod's rage.

The following is a list of the more notable obelisks, with their present sites, sizes, etc.:

OBELISKS.

Present Site.	Size.	Height.	By or to whom Dedicated.
	ft. in. ft. in.	ft. in ft. in.	
Heliopolis	6 1 × 6 3	68 2 or 66 6	Osortisen, 2,851 B. C.
Biggeg-Crocodopolis .	6 9 × 4 0	43 ft. 0 in.	Ditto.
Karnak	. . . . .	90 6	Thothmes I.
Ditto	Mariette.	108 10	Hatasou, 1,660 B. C.
Lateran, Rome . . .	9 8 × 9 10	105 6	Thothmes III.
Vatican, Rome . . .	8 10	82 9	No hieroglyphs.
Alexandria *	7 7 × 8 2	70 0	Thothmes III.
London	7 10¼ × 7 8	68 5½	Ditto.
Constantinople . . .	Broken.	50 0	Ditto.
Sion House	0 10⅞	7 6	Ditto.
Thebaid, Alnwick . .	0 9¾ × 0 9	7 3	Amenotep II.
Porta del Popolo, Rome	8 5 × 8 5	78 6	Seti Menepthah I.
Trinità del Monti, Rome	4 3	43 6	Ditto.
Luxor	. . . . .	82 0	Rameses II.
Paris	8 0 × 8 0	76 4	Ditto.
San, or Tanis	. . . . .	. . . . .	Ditto.
Monte-Citorio, Rome .	. . . . .	71 5	Sesostris.
Piazza Navona, Rome	4 5	54 3	
Pantheon, Rome . . .	Fragment.	50 0	Ditto.
Villa Mattei, Rome .	8 3		
Piazza Minerva, Rome	Fragment.	17 0	
British Museum, 2 . .	1 6 × 1 5	8 2	Amyrtæus I.
Constantinople . . .	6 0 × 6 0	35 0	Nectancho I.
Corfe Castle, Philæ .	2 2	22 1½	Ptolemy Evergetes II., 150 B.C.
Benevento	. . . . .	9 0	
Monte Pincio, Rome .	. . . . .	30 0	Hadrianus.

*Presented to the United States.

—*Scientific American Supplement.*

GEOLOGY.

THE PRESENT STATE OF THE EVIDENCE REGARDING THE ANTIQUITY OF MAN.*

BY T. MCK. HUGHES, M. A., WOODWARDIAN PROFESSOR OF GEOLOGY, CAMBRIDGE.

[The following paragraphs, discussing the evidence as to Man's existence in or before the Glacial era in Europe, and the remarks succeeding, by Professor Dawkins, are cited from a paper bearing the above title.]

We may dismiss at once the case [of supposed human remains], reported

*Read before the Victoria Institute, 1879.

XUM

from the Dardanelles, of works of art found in deposits said to be of Miocene age. The descriptions* prove that it was not given on the authority of one competent to judge in such a case, and it never has been confirmed.

In beds said to be Miocene, at Thenay, near Pontleroy, the Abbè Bourgeois found flints which he supposed were dressed by man. These flints are now exhibited in the Museum at St. Germain, where I saw them with Sir Charles Lyell several years ago, and again with others since. Some of them seemed entirely natural, common forms, such as we find over the surface everywhere, broken by all the various accidents of heat and frost and blows. A few seemed as if they might have been man's handiwork—cores from which he had struck off flakes such as we know were used by early man, of which I show examples. Yet this is not quite clear, for, had the evidence been good that they were found in place, there still would have been a doubt whether they were man's work. But when we came to inquire about the evidence that they occurred in beds of Miocene age, we learned that only those that we put down as natural were found by the Abbè himself; the others were brought in by workmen, picked up, we may suppose, upon the heaps turned over by their spades, and so perhaps, just dropped down from the surface.

Next in the Crag the teeth of sharks, bored through, as if for wear, were found,† part of a string of ornaments such as are commonly worn by savages. Of these I give examples: one a boar's tusk, from the lake dwellings of Switzerland; another, a tooth from a deposit of palæolithic age, in a cave just above the miracalous grotto of Lourdes in the Pyrenees. I have examined fragments of bone and teeth [from the Crag] of various sizes and shapes, and found them marked over the surface with many a pit or deeper hole, or even perforation irregularly placed, not as if by design, but by accident. There they were in every stage, all over, yet of one type. One sawn across explains the whole. The chamber of a shell which bores its way into the solid rock or softer shale was clearly shown. When the mass lay embedded in the mud it was but touched here and there. If it was thin the animal bored through into the sand or clay below, piercing the tooth quite through—a perfectly well-turned and finished work, so good it was thought to be man's. But if the mass was thick and near the surface, the little mollusk made a home entirely within it, and its shell often remains there, and reveals the history and manner of formation of the holes.

An account has also been given by the Abbè Bourgeois of flints from Pliocene beds at St. Prest, near to Chartres, said to be worked by man, but this we may dismiss on the same ground as those before referred to given on the same authority.‡

Another case brought forward from abroad but recently, has found as much favor here as there.§ Around the Lake of Zurich there are left traces of ancient lakes at somewhat higher levels. A bed of clay below with glacial stones, a bed

*Journ. Anthrop Inst., vol. iii, p. 127, April, 1873.
†Journ. Anthrop. Inst., vol. ii, p. 91 April, 1872.
‡Bourgeois, Congr. Inter. d'Anthrop., 1867, p. 67.
§Rutimeyer, Archiv. fur Anthropologie, 1875; Heer, Primæval World of Switzerland.

of plants between, half-turned to coal, a mass of clay, moraine-like on the top, tell of the time when Alpine ice crept farther down the hills, and touched upon the lake, now more, now less encroaching. In these beds the peaty mass of lignite, known as Dürnten coal, was largely dug for fuel. I have worked a long time down below to see the evidence myself. The sequence of the beds is clear. But recently two Swiss professors have proclaimed that they have obtained proofs incontestable that man was there, and wove a basket, fragments of which were found among the drifted plants which formed the coal. These fragments, it is said, consist of pointed sticks, sharpened across the grain, not tapering naturally, and a cross set of binding withes, all now pressed and changed, but by such characters referred to work of man. Now I have found myself along the shore fragments of wood and twigs half decomposed and waveworn till they were cut to a point obliquely to the grain, as they describe the Dürnten sticks. Across such fragments often others fell, and when the whole was then compressed what wonder if they left a mark of wattle or of basket-work? and the whole mass has suffered such great pressure from the superincumbent weight of clay that all the round twigs and stems are squeezed quite flat, as in the specimens before you. These Dürnten pointed sticks, however, I have not seen, and, therefore, speak with caution, showing only how I think the thing might be otherwise explained.

Widespread beds of loam and sand, and gravel, cover the lower levels of East Anglia; and, probably ranging over a vast period, have been collectively described as "middle-glacial," for below are glacial beds, and in the middle series bowlder clay, and over them, whether in part *remanie* or not, another bowlder clay. Lying in hollows and on the flanks of valleys, cut through this ancient loam and other beds, are river terraces of later date; and these, because in great part made up of the older beds, are like them, and require experience to distinguish. In these old terrace-deposits implements of man's undoubted work have long been found; but recently it has been said that some of these beds belong to the older series.‡ This, then, becomes a matter of opinion. For my part, being well acquainted with the deposits in question, and having listened to the evidence, I give my testimony quite against the Glacial or inter-Glacial age of any of the beds from which the hatchets came. It is, however, said that other evidence has since been found, conclusive as to this. I can but criticise that which has been adduced; but I will say that if such has been found and been so long withheld, while there are so many deeply interested, and so many who would like to verify at once and on the ground, the statements made, then I do hold that there has not been shown that love of full investigation which is the soul of science.

In many countries where rocks of limestone tower in cliffs and crags above the valleys, and are tapped below by undermining streams, the rain which falls upon the higher ground is lost in cracks and joints, and carries off the rock dissolved in water, which contains a little acid caught by the falling rain or drawn from decomposing plants. The fissures thus enlarged into the gaping chasms called "swallows' holes," the "katabothra" of the Greeks, admit a copious tor-

‡Mem. Geol. Surv. Geology of Fenland.

XUM

rent, carrying stones and sand which grind and bruise and open out the jointed rocks into great caves and subterranean courses. These, when tapped at lower levels, are soon left dry, and offer to prowling beasts of prey a safe retreat, and often man availed himself of them, as testify the Adullamites and Troglodytes of every age.

From such a cave up in the crags of Craven some evidence is adduced tha man existed far back into Glacial times, and this, perhaps, is the best case that has been urged* There a large group of animals, such as occur elsewhere along with man, and more doubtfully, traces of man himself, were found in beds over lapped by Glacial clay which had sealed up the mouth of the vast den in which these relics lay. This excavation I have watched myself at intervals from the commencement, and I hold that as the cliff fell back by wet or frost, and limestone fragments fell over the cave mouth, with them also came masses of clay, which, since the Glacial times, had lain in hollows in the rock above. We dug and found such there, and, more, I observed that the clay lay across the mouth as though it had thus fallen, and not as if it came direct from Glacial ice that pushed its way athwart the crag in which the cave occurs. It seemed to have fallen obliquely from the side where the fissured rock more readily yielded to the atmospheric waste, so that it somewhat underlay the part immediately above the cave. On the inside the muddy water which collected after flood, held back by all this clay, filled every crevice and the intervals between the fallen limestone rock, while still outside was the open *talus* of angular fragments known as "screes."

These are the most important cases that I know where man has been referred to Glacial or inter-Glacial times; but, all, it seems to me, quite inconclusive. On the contrary, there is much in them, and much besides, pointing the other way. In support of which opinion I will now offer some independent evidence, showing that some similar beds with man and the beasts that are found with him in earliest times can be proved to be post-Glacial. * * *

[*Remarks on the foregoing paper by Professor W. Boyd Dawkins, F.R.S.*]

I entirely hold with Professor Hughes in the view which he takes relating to the antiquity of man, and the necessity of looking narrowly into facts bearing on the question. All the alleged cases of the existence of man before the Palæolithic age, on the Continent, seem to me on a careful inquiry to be unsatisfactory. If the flints found at Thenay, and supposed to prove the existence of Miocene man, be artificial, and be derived from a Miocene stratum, there is, to my mind, an insuperable difficulty in holding them to be the handiwork of man. Seeing that no existing species of quadruped was then alive, it is to me perfectly incredible that man, the most highly specialized of all, should have been living at that time. The flints shown in Paris by Professor Gaudry appear to be artificial; while those in the Museum of St. Germain appear to be partly artificial and partly natural, some of the former, from their condition, having been obviously picked up on the surface of the ground. The cuts on the Miocene fossil bones

*Tiddeman, Brit. Assoc. Reports, 1870-8.

discovered in several other localities in France may have been produ ed by other agencies than the hand of man.

Nor in the succeeding Pliocene age is the evidence more convincing. The human skull found in a railway cutting at Olmo, in Northern Italy, and supposed to be of Pliocene age, was associated with an implement, according to Dr. John Evans, of Neolithic age. Some of the cut fossil bones discovered in various parts of Lombardy, and considered by Professor Capellini to be Pliocene, were undoubtedly produced by a cutting implement before they became mineralized, a point on which the examination of the specimens leaves me no reason for doubt. I do not, however, feel satisfied that the bones became mineralized in the Pliocene age; and the fact, that only two species of quadrupeds now alive then dwelt in Europe, renders it highly improbable that man was living at this time. This zoölogical difficulty seems to me insuperable.

The only other case which demands notice is that which is taken to establish the fact that man was living in the inter-Glacial age, in Switzerland. The specimens supposed to offer ground for this hypothesis consist of a few pointed sticks in Professor Rütimeyer's collection at Basle, of the shape and size of a rather thin cigar, crossed by a series of fibers running at right angles. They appear to me after a careful examination to present no mark of the hand of man, and to be merely the resinous knots which have dropped out of a rotten pine trunk, and survived the destruction of the rest of the tree. As the evidence stands at present, there is no proof, on the Continent or in this country, of man having lived in this part of the world before the middle stage of the Pleistocene age, when most of the existing mammalia were alive, and when mammoths, rhinoceroses, bisons, horses and Irish elks, lions, hyenas, and bears haunted the neighborhood of London, and were swept down by the floods of the Thames as far as Erith and Crayford. —*American Journal of Science.*

PSYCHOLOGY.

AUTOMATIC MENTAL ACTION.

BY PROF. J. M. LONG.

The development of the life of man depends upon the dynamic arrangements in his constitution for action. Those who study man from both the physiological and the psychological point of view, should, therefore, take into the account all those springs of action with which the Creator has endowed him. That part of the physical nature of man directly concerned in action is the nervous system, the functions of which are the generation, transmission and distribution of motion. That part of the nervous organism known as the Cerebro-Spinal system may be properly termed the Physical Mechanism of Mind, because psychical phenomena

XUM

are conditioned by its action. Psychical, or mental action, assumes three distinct forms, namely, Reflex, Latent, and Conscious.

We have two kinds of reflex mental action—one natural and instinctive; the other artificial and acquired. Reflex mental action is that form of psychical phenomena which occur without the intervention of consciousness, and which, though unconscious, accomplish ends analogous to those which take place under the direction of thought and volition.

We have what is termed a reflex psychical action when impulse is sent along an afferent nerve from the surface of the body, and which, on reaching the sensory ganglia, is reflected or thrown back along an efferent nerve, in the form of muscular motion. In this case an ingoing movement, resulting in a sensation, is converted into an outgoing movement without an intervention of consciousness. Such movements are called Automatic, because they are effected through the medium of the nervous mechanism mechanically, like the movements of automata. Illustrations of this class of psychic actions are furnished in the batting of the eyes when some object is suddenly thrust before them; in the unconscious throwing out of the hands to stay the body when about to fall; in the drawing up of the feet of a sleeping person when the soles are tickled.

To ascertain the seat of reflex psychical action, has been one of the interesting and important questions of modern psychology. The study of psychical phenomena from the objective point of view has proved that the brain is not the sole seat of mind. The seat of consciousness is in the brain; but the other forms of mental action cannot be restricted to that organ, but are developed, with more or less intensity, in the other parts of the nervous system. Consciousness is the eye of the soul, and is, therefore, a faculty. But it does not thence follow that the mind is active only when this faculty is active. The mind has other sources and springs of action. Descartes, followed by many philosophers, identified consciousness with mind, as though one should confound seeing with perceiving. Unconscious mental action we regard as the basis and condition of conscious mental action. In pure reflex actions, the brain, or cerebrum, takes no part. They are effected through the medium of the spinal cord and the other motor centers, of which the cord is a prolongation into the base of the brain. Hence, animals of a low order, being more tenacious of life than those highly developed, when deprived of their brains will still perform reflex movements. Brainless pigeons will smooth down their feathers; brainless frogs will rub off sulphuric acid which has been dropped upon them, or adjust themselves on a board as it is inclined at different angles. Infants, born without brains, have been known to perform the usual operation of sucking. There is said to be a man in a French hospital who, in consequence of a wound received in the late war with Germany, passes out from his normal conscious life once in each month, and lives, for a day or two, a life of unconscious reflex action, like a decapitated frog or pigeon. He neither sees, hears nor tastes, nor smells, having only one sense organ in a state of activity, namely, that of touch, which is exalted into a state of preternatural

acuteness. Yet, without consciousness, he is said to go through his daily routine of movements with automatic regularity. All those accustomed actions he performs through the medium of the spinal cord and the other motor centers, independently of the brain.

Primary reflex mental action constitutes the innate and fundamental provision in the human organism for the maintenance of life. The conditions of life require that there shall be something from which to start at the time that the animal sets up an independent existence, in order that the organism shall be, to a certain extent, in harmony with environing relations. This primitive and innate provision for action is called Instinctive, because it is original and unacquired, and exists in its full power previous to experience and instruction. Man, at birth, begins a life without knowledge and experience. In this condition, his only guide is instinctive reflex action, until intelligence and volition become developed. Hence, instinctive reflex action forms the basis upon which all subsequent mental development and education take plaee.

The organism of man is arranged in harmony with a fixed and preëstablished system of nature. To render the development of the organic and mental life possible, the rudimentary psychical nature must begin in unconsciousness, or reflex action, in harmony with the conditions imposed by external relations. As intelligence and will become developed, the mind rises into a consciousness of this preëstablished harmony which from the beginning has rendered the development of life, both mental and organic, possible. Thus the mind grows and develops from simple reflex action—which presents psychical phenomena in their lowest typical form—into conscious volition, in which the intelligence adjusts itself to the complex relations of space and time. We thus recognize simple reflex action as the germ out of which will is developed. Hence, to understand the nature of will, we must study it in its genesis as related to reflex action. It is also by studying primary reflex action that we become prepared to understand the nature of secondary reflex, or automatic action.

Secondary automatic mental action is one of the important contributions of modern psychology to mental science. Even after this doctrine had been stated and received as the only theory which could explain a certain class of mental phenomena, it was stoutly opposed by the metaphysical school of thinkers. Secondary automatic mental action belongs to that class of psychical activities which have, by the force of habit, assumed the form of aptitudes, and which go on without an effort of the will. Actions which, at first, require all one's attention, may, after many repetitions, become automatic, and go on, of their own accord, through the operation of the lower nerve centers, without a conscious effort of mind. The larger part of our daily mental actions which constitute the efficient machinery of life, is of this character, such as walking and reading aloud while the mind follows the thoughts of the author. If all the actions and mental processes which the necessities of our daily life impose upon us had to be brought under the review of consciousness, it would be burdened down with the weight of complex details.

XUM

The use and value of consciousness as a mental element in running the machinery of mind do not lie in what it is in itself, but in what its separate and successive states may become. By continual repetition, these separate states may become organized into a consolidated whole, which, like the individual cells in the animal organism, finally develops into a complex form of automatic mental action. Hence, the mental machinery does not consist in separate conscious states, but in organized forms of action into which the mind has grown by the force of repetition.

The fact of mental automatism finds its explanation on the physical side of being in the relation which the cerebrum sustains to the lower sensory and motor centers. Impressions are made on the cerebrum by being propagated upward through the sensorium. These impressions, after being combined and co-ordinated, are reflected downward to the motor centers which execute the mandates of the will in the form of muscular movements. By constant repetition, these motor centers grow into the modes of action which have been consciously and artificially imposed upon them, so that the only conscious effort required to set them going is a mere initiative impulse of the will. In this way the mental and the physical organism may be made to take on themselves an artificial and secondary automatic action, as distinguished from that which is natural and primary.

We should not pass over this part of the subject without calling attention to the important office which this form of action performs in the economy of human life. We should regard the spinal cord, together with the motor and sensory ganglia, in which it terminates, as charged with spontaneous force, and as consequently the seat from which emanate "the lightning gleams of power" exerted for the well being of the organism. Man must have some provision in his constitution which shall serve as a guide and protection, before he can rise into the dignity of an intelligent and conscious being. Such are the dangers to which life is often exposed, that action must come before thought to save the organism, or some part of it, from destruction.

Automatic mental action has a most important bearing on education, whether this looks to physical, intellectual, or moral and religious training. It is that, in fact, which makes man an educable being. It is only the new school of psychologists who, as yet, fully recognize the great value of this form of action as one of the capacities of our physical and mental being. "It is," says Huxley, "because the body is a machine that education is possible. Education is the formation of habits, a superinducing of an artificial organization upon the natural organization of the body; so that acts, which at first required a conscious effort, eventually become unconscious and mechanical. If the act which primarily requires a distinct consciousness and volition of its details, always needed the same effort, education would be an impossibility." "The acquired functions of the spinal cord," says Dr. Maudsley, "and of the sensory ganglia, obviously imply the existence of memory, which is indispensable to their formation and exercise. How else could these centers be educated? The impressions made upon them, and the

answering movements, both leave their traces behind them, which are capable of being revived on the occasion of similar impressions. A ganglionic center, whether of mind, sensation, or movement, which was without memory, would be an idiotic center, incapable of being taught its functions."

The educators of youth should never lose sight of the fact that their work is well done only when both mind and body have been trained to act with automatic readiness and precision. This high degree of mental and physical power and specialization can be attained only by incessant repetition. Practice, and practice alone, makes perfect.

All beginnings are difficult; but, by virtue of this capacity for automatic mental action, they become easy and pleasant, so as to require little or no effort of the will to spur the mind on to its accustomed work. After this form of mental action has once been acquired, the mind is no longer perplexed with the routine of petty details, but is left free to attend to the few unaccustomed matters which turn up during its regular work, and which require a distinct consciousness.

The educator of youth, in availing himself of this spring of action, must take into the account the question of vital dynamics. Unless he does this, he is liable to err in two particulars: first, as to the extent to which this form of mental action should be carried; second, as to the class of mental operations to which it should be confined. Automatism requiring long and laborious repetition must make a heavy draft upon the plastic energies of the brain. The consumption of all the nervous energy in organizing automatic forms of action would result in a deadening of consciousness, and tend to reduce the mind to the level of a machine. Prof. Huxley says that he would not object to being thus reduced, provided that when wound up in the morning, like a clock, he would run on with automatic precision, and never go wrong. But such a result, if possible, would not be desirable, for the reason that it would put an end to all further mental progress in making new acquisitions. Mental operations by repetition tend to wear for themselves a channel. The nervous mechanism embodies in its structure the impressions made upon it as a part of its organic growth. But this mechanism of nerves is truly a machine, governed by mechanical laws, and is hence capable of performing only a limited amount of work. If a certain amount of the brain force be consumed in impressing upon the organism a particular form of action, just so much less will be left as a stimulus for exciting the mind to other acquisitions. Hence, if automatism has been carried to excess, the effect upon the young and growing organism must be injurious. The rigid and automatic condition of the nervous mechanism produced by habit, brings on a corresponding rigidity and deadness of consciousness itself, thus rendering the mind incapable of further progress. Automatic action gives efficiency and ease of execution; but, if carried too far, renders it difficult and even impossible to make new acquisitions.

It is also evident that automatic action should be confined to those mental and physical movements which will be of daily use, which look to the practical side of life, and which, from their nature, must be largely automatic to fulfill their

ends. Learning to play on the piano, or other musical instrument, must attain to automatic quickness, to give that ease and readiness of execution which the nature of the process demands. The fundamental operations of arithmetic should be so thoroughly learned as to be largely automatic. When these fundamental processes of numbers have become organized, as it were, in the mental organism, the mind is then left free to attend to the logical processes involved in the mathematical operations. But, for the reason that automatism is an expensive acquisition, it should be limited to such mental operations as necessarily demand it. Those operations which can be well performed by deliberate thought, should be left to the conscious control of the will.

1. The education of the mental organism into automatic action should begin early, while the nervous system is plastic and impressible.

2. One of the practical problems of education is to duly antagonize consciousness and automatism.

3. The energies of childhood should not be utilized in the automatic demands of business, for this would bring on an arrested development of mind and body.

4. The mental life of the school demands that provision should be made for the exercise of both these forms of mental action, the automatic and the conscious.

PHYSICS.

A TALK ABOUT LIGHTNING.

F. W. CLARKE, PROFESSOR OF CHEMISTY, UNIVERSITY OF CINCINNATI.

A year or two ago a house not far from Cincinnati was struck by lightning, and its inmates were pretty well scared. Among them was quite an intelligent young lady, recently from school, who had studied a little about electricity, and knew that metals would attract the spark. The flash had fallen, the danger was over, but her panic remained; and in her fright she rushed eagerly down stairs in search of a pair of scissors with which to cut the steel buckles from her shoes. This act, comical as it seems in all its bearings, was yet based upon rational grounds. To be sure it was like closing the stable door after the horse had been stolen; of course the young lady might simply have removed her shoes; and we all know, moreover, that lightning does not generally attack its victims' feet first, unless, indeed, they happen to be sitting in what might be termed the bar-room attitude. Yet the fact remains that the wearing of metals during a thunder storm slightly increases the danger of the wearer. The metallic object has a determining influence upon the course of the flash. In one instance a lady's bonnet, because

of its wire framework, was entirely consumed by lightning, although the lady herself escaped serious injury. Another lady inadvertently thrust her arm out of a window during a thunder shower, and her gold bracelet was dissipated in vapor. Still another flash of lightning found a gentleman seated on the top of a stage coach and rifled his pocket of a valuable watch, leaving only a few links of the chain. The general fact which our heroine had in mind is, then, quite clear. Only her peculiar application of it serves very well to illustrate the crudity of popular notions about lightning. Many people are so bewildered and dazzled by the flash, and so stunned by the explosion which follows, that they become unable either to appreciate the beauty of the display, or to reason correctly concerning its nature. Indeed, very few persons realize how varied are the phenomena presented by the lightning in its color, its form, and its effects, and still fewer understand in more than a vague, general way, the principles involved in the erection of conductors. Every summer the country is scoured by lightning-rod agents, each with some eccentric contrivance to sell, who not only take advantage of the popular ignorance, but even make it deeper still. Spiral rods, patent tips, novel insulators, and goodness knows what else, are carried from house to house and forced upon the attention of puzzled listeners with an assiduity worthy of better employment. In consequence, a great many of the rods put up are not only unsuitable and inefficient, but also much more costly than thoroughly good, substantial and adequate conductors even need to be.

Lightning, by the best observers, has been divided into three kinds. First, there is the common zigzag line of light, sometimes as much as ten miles long, which seems to shoot from point to point with great velocity, and which lasts, it has been estimated, only about the thousandth part of a second. Secondly, there is what is known as "sheet lightning," in which vast masses of clouds are suddenly illuminated, as if from behind, no line being seen. This flash is also of inconceivably short duration, and varies much in color. White, blue, purple, violet, and rose-color are common tints for it to have. With it may be classed the so-called "heat lightning" of hot summer nights, which is probably but the reflection of active lightning at a distance. It is worth noting in this connection that thunder is rarely heard more than ten miles away, so that the flashes are often visible when no sound can be detected. The roar of artillery, as at Waterloo, has been audible at a distance of over eighty miles from the scene of battle. The third kind is called "globular lightning," and is comparatively rare. It appears like a ball of bluish fire, rolling with relative slowness on or near the surface of the ground or of the sea. When it reaches certain obstacles the ball explodes with a loud noise and works much mischief. When two young ladies were killed by lightning on the Malvern Hills, England, in June, 1826, the discharge was described as a globe of fire which rolled slowly along the ground toward the building in which they had taken shelter. Such a globe has been known to remain in sight for at least ten seconds. Another remarkable case of this kind of lightning is mentioned by Mr. Chalmers, who saw it from on board

ship in 1749. His attention was called to a ball of blue fire, as big as a millstone, which was rolling along the surface of the water three miles away. Very soon it reached to within forty yards of the main chains, when it rose perpendicularly with a fearful explosion, and shattered the maintopmast to pieces. Still another instance of a sort of globular lightning was furnished by the great storm in Brittany in 1718, during which twenty-four church towers were damaged. Three globes of fire, each more than a yard in apparent diameter, fell at once upon a spire near Brest, destroying the church completely.

I need say little of the nature of lightning, since everybody is familiar with the story of Franklin and his kite. Every child knows that the flash is produced by the discharge of electricity accumulated in the clouds. But atmospheric electricity may become manifested in either of two different ways. When lightning is seen we observe what is called a "*disruptive* discharge;" while in the phenomenon best known as "St. Elmo's Fire" a "*glow* discharge" takes place. The latter is harmless, and rather rare. Occasionally its peculiar brushes or balls of fire tip the ends of masts and spars during storms at sea, as many as thirty of these flames having been seen on one vessel at the same time. Once in a while, too, it is produced on land. Troops of soldiers have been terrified at finding the tips of their lances or bayonets adorned with mysterious fires. Similar flames have decorated the hair and the finger ends of travelers caught in a storm above the snow line in the Alps. A wagon loaded with straw has been so electrified that every straw seemed to be in a light blaze. And at Plauzet in France the three points of the cross upon the church were seen surrounded by flame during every thunder-shower for twenty-seven consecutive years. But with these glow discharges we have little to do. The disruptive discharge concerns us, especially with regard to its effects.

These effects may be conveniently studied under two heads; first, the effect of the lightning upon the air through which it passes; secondly, its effect upon the object struck. The first of these heads needs to occupy our attention but very briefly. Often after a thunderstorm, especially near articles which have received the flash, a peculiar odor is perceived. This odor is commonly described as a "brimstone smell," and, taken in connection with the bluish, sulphurous color of the spark, has led people to imagine the actual presence of sulphur in the storm. But the odor really belongs to ozone, a modification of oxygen produced by the passage of an electric spark through that gas. Three volumes of oxygen have been condensed to two, and the product has the pungent perfume so well known.

But it is when we come to consider the effects produced by lightning upon the objects which it strikes that we reach the most interesting ground. Some of these effects have already been described or hinted at, and most of them are so familiar to everyone that they seem hardly to need extended notice. Yet the material is so abundant and so varied that it becomes easy to select many interesting illustrations of our subject. Take for instance the formation of "*fulgurites*"

in the soil. When a flash of lightning strikes a bed of sand it penetrates downward with great force for many feet, partially melting the sand on the way. Deep vitrified tubes are thus formed, fragments of which can easily be preserved as curiosities. These are known as "*fulgurites.*"

The mechanical effects produced by lightning are often of the most stupendous character. In June, 1764, the steeple of St. Bride's in London was struck and damaged. A stone weighing seventy pounds was flung fifty yards, and an iron bar two feet long was broken in two, one piece of it being bent back upon itself at an angle of forty-five degrees. When the ship Le Patriote was struck in 1852, a block of wood weighing about one hundred and sixty pounds was torn out from the mast, and flung with its thicker end against a massive plank partition, a hundred paces away, so violently as to become firmly imbedded in the obstacle. A still more remarkable effect was produced when the ship Desirée was struck in Port Antonio harbor, Jamaica, in 1803. The maintopmast was broken in two, and the next morning one-half of it was found sticking in the mud on one side of the harbor, while the other half lay in a lumber yard upon the opposite shore. Again, the ship Rodney was struck by lightning in December, 1838. The top gallant and royal masts, fifty-three feet long and weighing about eight hundred pounds, entirely disappeared from the vessel, with the exception of the end of the royal mast. The sea was covered with chips and splinters, and the water alongside looked as if it had received all the refuse of a carpenter's shop. The mainmast was bound by twenty-six great iron hoops, and of these thirteen were burst asunder and thrown down upon the deck. Each hoop was half an inch thick and five inches wide.

These instances serve not only to illustrate the power of the stroke, but also the special liability of ships to receive it. Their long, slender masts, rising amid an almost level wa te, offer the best possible work for the celestial fires. Indeed, a ship has been known to receive seven distinct flashes of lightning in the course of a few minutes. But the mechanical injury which a ship receives is not always its greatest damage. The electricity is apt to derange the compass, and play strange freaks with the chronometer. In consequence of these disturbances many a ship has been lost long after the danger seemed quite over. The packet ship New York, which was struck twice during a storm in the Gulf Stream in April, 1827, although it came safely to port, had particularly severe experiences. The waves ran very high, the vessel was surrounded by waterspouts, the rain was mingled with hailstones as large as filberts, and the lightning was flashing in all dire tions with simultaneous reports. The main discharge, which made the ship lurch so violently as to throw down people standing upon deck, fell on a pointed iron rod about four feet long, melting a few inches of its point. From this rod an iron chain one-fourth of an inch in diameter, a wholly inadequate conductor, descended to the water. This chain was knocked in pieces, and some of its links made to burn like a taper; while drops of melted iron fell to the deck setting fire to the woodwork wherever they touched. When the ship reached Liverpool it

was found that the compass had been completely demagnetized; while on the other hand the steel work of the chronometer had been affected in the opposite manner, and the instrument accelerated over half an hour.

Powder magazines have also been made the particular favorites of lightning stroke. Many of them have been exploded by lightning, and thousands of lives lost. But no magazine protected by a suitable rod has ever been thus damaged. Such have been struck, but the shock has always been carried off harmlessly into the ground. The greatest disaster ever worked by lightning was doubtless that which happened at Brescia in 1769. The tower of St. Wazaire, having 207,600 pounds of gunpowder stowed beneath it, was struck and the powder fired. The tower rose bodily into the air, to return in a shower of stone; three thousand persons were killed, and about one-sixth of the city destroyed. Thirteen years later Fort Marlborough in Sumatra was struck, and four hundred barrels of powder exploded.

When living beings become the subjects of a flash of lightning the effects may vary quite considerably. In one case which happened about a year ago, a man's boots were torn from his feet by lightning, while he himself was only stunned. In another instance a lady was lying in bed, and the flash entered her window and singed away her hair without doing much other mischief. Other freaks of lightning were mentioned at the beginning of this article. When death results from such a stroke the body may present any one of a great number of appearances. It may be almost unmarked, or covered with burns. Livid welts sometimes appear upon it, as if the flesh had been bruised by a blow. Sometimes impressions, we might almost say photographs, of near objects are imprinted upon the skin. A man was killed by lightning at Zante in 1836, and marks of coins which he had carried in his pocket were found stamped upon his person. Yet the coins themselves were at a considerable distance from the marks! Such a death is probably painless. The electric shock moves so much more rapidly than the nervous impression that the victim dies before he has time to become conscious of injury. The lower animals seem to be in special danger from lightning. Instance after instance could be cited in which animals have been killed in close proximity to men while the latter remained unharmed. A ploughman was once ploughing with four oxen. Being struck by lightning, both man and beasts were overthrown. The man, however, was but slightly stunned, while two of the oxen were killed outright, and a third paralyzed. According to D'Abbadie, a single flash of lightning in Ethiopia destroyed two thousand sheep. Even the fish are not exempt from the paralyzing influence. When lightning falls upon the water many of its inmates are killed.

Fortunately the danger from lightning can be diminished by certain precautions. Some of these are quite generally known. For instance, one should always keep away from all large masses of metal, and from isolated trees. But although isolated trees are such dangerous companions during a thunderstorm, a man is but little exposed to risk in a dense forest. Trees may be struck in the

latter, but they are less likely to be than when standing alone in the midst of a level plain. Safety is also found in deep narrow valleys or ravines. Lightning rarely reaches to the bottom of such places, but is scattered against their sides. The wearing of silk is said to be a safeguard against lightning, and the case of the church at Chateauneny les Moutiers in the Lower Alps has been cited to confirm this view. The church was struck during divine service on the 11th of July, 1819. Nine persons were killed outright, and eighty-two wounded. Two of the three officiating priests were injured, while the third, who wore a silken robe, escaped. One more fact is worth noticing in this connection. Whenever any number of men or animals standing in line are struck by lightning, the individuals at the ends of the line always suffer the most severely, Many examples of this are on record, but one will suffice for us. Thirty-two horses standing in line in their stalls were once struck by lightning, and thirty of them were knocked down. But only two were killed, and they formed the extremities of the line.

Although at first sight lightning seems to act so capriciously, leaping from point to point in the most irregular manner, and playing tricks more freakish than those of Puck, it yet moves in accordance with rigid, definite laws. Certain substances are better conductors of electricity than others, and even the same substance varies in its conducting power according to conditions. Differences of temperature, of internal structure, of form, and of surroundings, will cause two samples of copper or iron to conduct electricity very differently. And the lightning in its course, fickle and irresponsible as it seems, invariably follows that path in which conduction is the best. In other words, it moves in the line of *least resistance*, and never leaves that line under any provocation. A river would as soon leave its bed and flow along the tops of the hills. Upon this general principle the construction of lightning-rods is based. A line of least resistance is artificially furnished, through which the flash may pass harmlessly into the ground. Occasionally, however, buildings which were apparently protected by suitable conductors have been seriously damaged by lightning. Hence many intelligent persons have been led into a distrust of lightning-rods. Some have even asserted that the rods not only failed to protect buildings from the effects of a stroke, but actually attracted the danger. But the difficulty always has been that the offending conductors were not properly arranged, or, in short, did not constitute the desired line of least resistanee. Many precautions have to be observed in the erection of lightning-rods, and to these we shall recur presently. Let us first see, however, whether there is evidence to warrant faith in good rods, and whether there is any truth in the notion that they increase the danger which they claim to avert.

Now a vast number of facts go to prove the efficacy of suitably arranged rods. The church at Antrasmes, for instance, was twice struck by lightning, the flash following both times in precisely the same track. Certain picture frames were ungilded, certain bars of metal destroyed, and the portraits of the saints blackened. A lightning conductor was finally applied to the building and it has not

been struck since. The chapel of Count Orsini in Carinthia, standing in an exposed situation, was so frequently struck and injured that divine service was no longer celebrated within its walls. But in the year 1778 a conductor was applied. Since then the edifice has been struck less frequently than before, and every stroke has been carried harmlessly away. A similar instance is furnished by the tower of St. Mark at Venice, 340 feet high. This tower was repeatedly and seriously damaged by lightning until in 1766 a conductor was put on. Since that time no harm has been done. The tower has passed unscathed through every storm. Still another example is offered by the cathedral at Sienna, which was a favorite victim of the lightning. After a while, about the year 1777, a rod was attached to the building, causing much anxiety among the ignorant neighbors, who called it the "heretic rod." Soon, however, another stroke fell upon the cathedral and was rendered harmless by the dreaded conductor. The natives began to respectt the "heretic," and have since had no cause to alter this feeling. I will cite one more instance, in which a flash of lightning, after working serious mischief, was caught up and tamed by a metallic chain. The ship Hyacinth was struck in the Indian Ocean in 1833. The top gallant and topmasts, forty feet long and weighing nearly eight hundred pounds, were knocked into bundles of laths which scarcely held together. At the base of these masts the electricity encountered an iron chain, fifty feet in length and made of half inch metal, which communicated with a copper pipe running through the vessel. By these conductors the flash was carried off safely. After reaching them the flash could do no more harm.

The question whether buildings armed with lightning-rods are more likely than others to be struck, is partly answered by some of the foregoing examples. But, had I space, I might cite evidence of a more convincing character. The matter has been many times tested by houses standing closely together, one protected by a rod, and the other without defense. Time and time again the unprotected edifice has been struck and damaged, while its neighbor, which should, according to the popular theory, have attracted the lightning, escaped altogether. The same thing has also been observed at sea. Two ships, the one equipped with conductors and the other not, have been exposed to a storm scarcely half a cable's length apart. And the flash has fallen, not upon the attracting conductor, but upon the masts of the unarmed vessel. In fact, nothing is more certain than that lightning rods do not increase the danger from lightning.

That a lightning conductor may be adequate to its purpose several things are needful. The rod must be made of proper material. It must be large enough to carry off any stroke which may fall upon it. It must be continuous throughout, it must terminate in a proper locality, and it must be in part at least protected against rust. Negligence on one of these points might render the whole affair worthless.

First, of what material should the rod be made? Of course, the better the conducting power of the material, the more efficient the rod. Now, but two

metals are practically available, namely copper and iron, the first of these conducting electricity about eight times as well as the other. Copper, then, is the best material. Next to copper ranks the so-called "galvanized iron," iron coated with zinc. The latter metal not only conducts better than iron, but protects the iron from rust. Common iron is the worst material of the three. The size of the rod is the next consideration. If copper alone is used, a half-inch bar will carry off any stroke which is ever likely to fall in our latitudes. Of galvanized iron a three-fourths inch rod should be used, but of common iron nothing less than an inch in diameter is a perfect protection.

Now, how shall the rod be constructed? Here we come into collision with certain popular whims. It is common to see rods carefully separated from the buildings they are intended to protect by neat little insulators of glass. These are utterly useless. An electrical spark which could break through the thousand or more feet of air intervening between the earth and the clouds would pay but little respect to the inch or so of space occupied by the insulator. Besides, if the path of least resistance lies in the lightning-rod the flash will not leave it for any more difficult channel. Another popular whim concerns the shape of the rod, many people having an idea that a spiral form is the best. This is a matter of no importance, and need be considered no farther. Let us begin at the tip of our rod. This needs to be protected from rust, and also to some extent against fusion. The latter difficulty may be gotten over by forking the tips, so that a flash falling upon it shall be divided into several parts. The other object is to be attained in several ways. The tip may be made either of platinum or aluminum, or it may be plated with nickel, or simply gilded. The last-named plan is the best and cheapest. The gilding costs but little, does not tarnish, and affords a surface of actually higher conducting power than either iron, aluminum, platinum, nickel, or zinc. Gold ranks next to copper in the scale of conductivity, silver standing at the head of the list. A silver tip, however, would be bad, for many reasons which need not be given here. As regards the body of the rod, this should be perfectly continuous throughout. No breaks should occur in it. Wherever joints are necessary the continuity of the conductor should be preserved by soldering. The lower extremity of the rod must be arranged with great care, and ought to extend several feet beyond where it leaves the building. If possible, it should terminate in a spring, well, or sheet of water, by means of which the electric shock may be scattered and lost. But by no means ought it to dip into a closed cistern or cesspool. A discharge of lightning, prisoned in such a place between stone walls, will send them asunder in order to escape. Ordinarily it is well enough to divide the lower extremity of a rod into several branches, and allow them to run about four feet deep into moist earth. By making the rod terminate directly under the waterspout, the earth into which it plunges may be thoroughly drenched at every shower. Another good plan is to fill a pit with several bushels of charcoal, which, previously heated to redness, has been suddenly quenched. The forked termination of the conductor is then buried in this pit. But such precaution is needed only where there is but very little moisture in the soil.

XUM

One more thing is needed. If several rods are placed upon an edifice, they should be connected with one another by horizontal rods like themselves. And they should also be connected directly with all large masses of metal upon the exterior of the building, such as gutters, spouts, cornices, crestings, balconies, or metallic roofings. Thus the line of least resistance may be made to communicate with nearly all parts of a wooden house, and the protection rendered more sure and complete.

Let me sum up these directions, fitting them for an ordinary dwelling house of moderate expense. I will not give a description of an absolutely perfect lightning-rod, but simply of one which will serve all common purposes. Make it of three-quarter inch galvanized iron, and let the gilded tip project as much as two feet above the ridge-pole or chimney top. See that it connects with the proper metallic masses, render it continuous to the ground, and conduct its termination, divided into three branches, either into a body of water, or else let it plunge four feet below the surface beneath your water-spout. With two such rods any dwelling of common size may be considered proof against the lightning.

Some trials were made lately on the Seine, at Paris, to determine the best way of breaking up river ice with dynamite. Bernard and Lay, assisted by two specialists, Flegy and Streits, of the Nobel Dynamite Company, directed the operations and recorded the results. The best effect was obtained by placing three cartridges of 406 grammes of dynamite beneath the ice, each connected with an electric machine on the bank of the river. When the cartridges were exploded it was found that the ice was shattered a distance of about eighty meters and through a width of from five to six meters. The pieces of the fractured ice were, moreover, found to be very small, and easily carried down stream past obstructions such as bridge piers.

The amphioxus, a fish-shaped animal of a very low grade of development which affords Haeckel one of his firmest stepping-stones in the lively work on evolution, has been the subject of very interesting observations on the part of Henry J. Rice, at Fort Wool, on the Chesapeake. He had the good fortune to find two males, a ripe female and twenty young. The animal stands on debatable ground between the vertebrates and invertebrates, and received its name from its shape. Amphioxus is the Greek of Mr. Yarrel for "sharp at both ends." Descriptions of the habits, structure and development of this curious primitive animal are being issued in the *American Naturalist* by Mr. Rice.

PHILOSOPHY.

CHOICE AND CHANCE.

BY FRANCIS E. NIPHER,
PROFESSOR OF PHYSICS IN WASHINGTON UNIVERSITY.*

In a lecture delivered in this city during last winter, and entitled "Thoughts on our Conceptions of Physical Law," some points were lightly touched which it seems desirable to develop more at length. For the sake of brevity, some of the statements which will be made have assumed a slightly dogmatic form. They are not so intended. Be kind enough to regard them as thoughts of the truth of which we are in some cases all more or less uncertain, which are submitted to the judgment of sober minds. It does not make a statement true if the whole world affirms it; the world has often blundered. This consideration suggests the frame of mind in which we should approach difficult subjects where men are likely to differ in opinion. He who comes to debate—to defend previously formed ideas—is at a disadvantage. It is difficult for such persons to place a proper value on the thoughts of others. In this manner the chances for error are increased. The method of the scientific man should be different. If he investigates phenomena, he seeks to use methods of experiment which eliminate from his results the personal bias of his own mind. He must learn to have no preference for one fact over another. He must learn to have no anxiety about the result. He must learn to be stringently honest with himself—a most difficult thing. If he works inductively, he should try to find out what *all* of the facts teach. If he has occasion to frame an hypothesis, and wishes to work deductively, then his work is, ***not to demonstrate***, but to ***test*** the truth of his hypothesis. In the debating school, young men are taught to defend assumed positions. In the Academy of Science it should be our only object to search for truth. When we differ it is better to *think*, rather than to dispute.

In the transaction of business we are constantly estimating chances, or probabilities. All our predictions for the future, even when based on the experience of centuries, are simply more or less probable—in no case certain. We cannot be absolutely certain that the sun will rise at its accustomed time to-morrow. It is wholly in accord with human experience and with the theory of probability, that very unexpected things will occasionally happen.

If we were to learn the contents of an urn, containing a million balls, by drawing the balls one by one, replacing them each time, we might, in course of time, gain a general idea of the contents; thus if 100,000 draws gave each a

* Delivered before the Kansas City Academy of Science, Feb. 18th, 1880.

white ball, we would properly decide that white balls are greatly in the majority, but we might continue for a century without drawing the single black ball that the urn might contain.

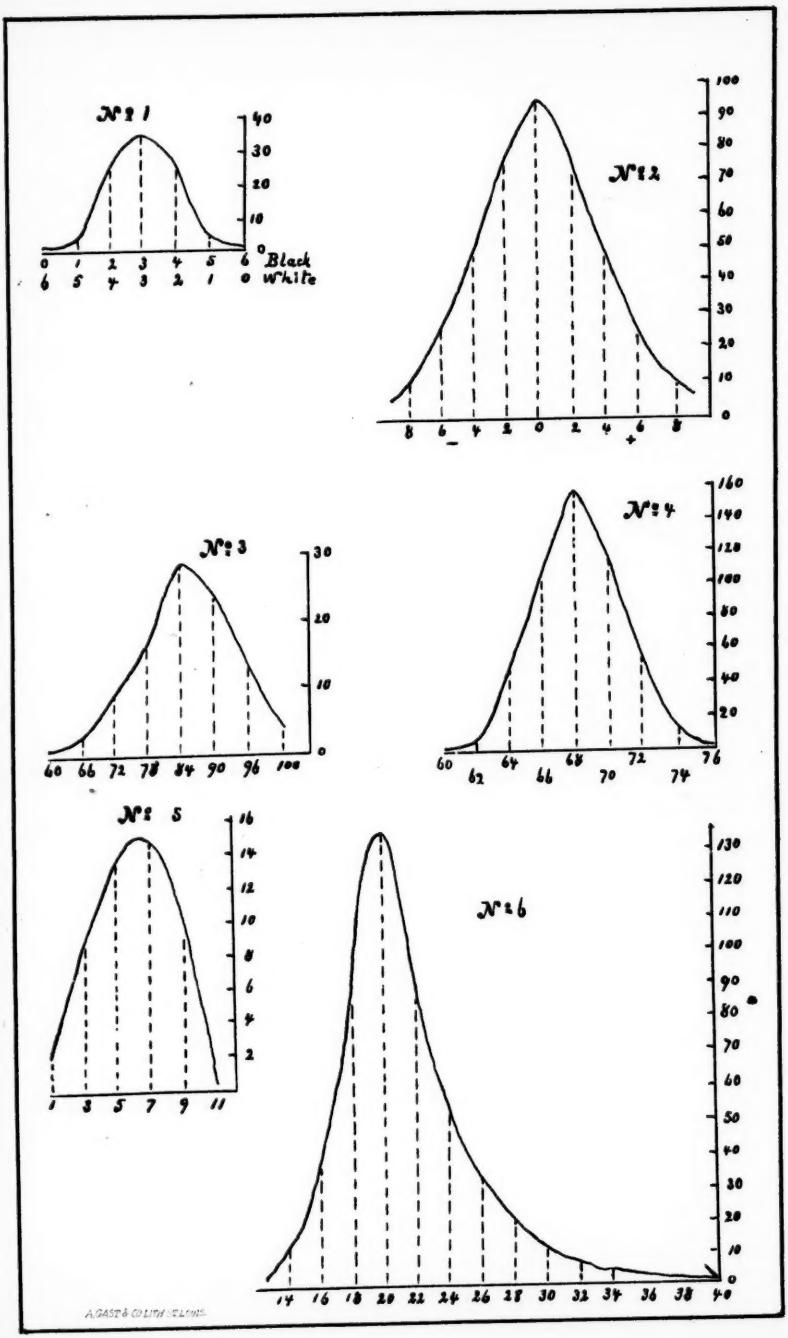
So it is with all human experience in this world. If we could range at will through space and time, we might well be surprised, as Tolver Preston has suggested, by the greatly varying conditions which we might find in other and unknown parts of the all-embracing universe; just as a minute being, inhabiting for a brief moment a single atom of a gas, and who might imagine that he had become quite familiar with his little world, would find much to learn, could he extend his observations over a longer time, or over a wider space. He would then find the greatest variety in the motions of neighboring molecules of the gas. Some moving with extreme slowness—others with extreme velocity—the same differences being observed in the velocities of their rotations. Moreover these velocities are being constantly changed, by collision of neighboring molecules—collisions which must often result in the separation of the molecules into their constituent atoms.

It may well be, as Preston ingeniously suggests, that all this is repeated on an immensely grander scale. Perhaps our solar system is rushing through space, with a motion compared with which the relative motions of its various parts are utterly insignificant. Collisions, instead of happening to each atom many millions of times per second, as in the case of gases, are here separated by immensely long intervals, and it is a minute portion of one of these intervals which represents the life-time of our humanity upon one of the atoms of the universe. Possibly we are not yet acquainted with the average conditions of the universe, our attention being confined, for a comparatively brief interval, to a few of the atoms which for the present are nearest to us.

We are able to predict the *probable* history of our earth, in the comparatively near future, but we know almost nothing of what the remote future may bring. Here we have fairly entered the domain of *chance*, which is the domain of human ignorance.

It is essential to bear in mind that probability is a thing which belongs, not to the events which are probable, but to the mind, depending as stated upon our knowledge, or rather upon what we think we know.

This is clearly shown by the fact that different persons may regard the same event with very different degrees of probability; for example: A thinks he saw a ball dropped into a box, and thinks he knows that it is yet there. B is certain that it was a juggler's trick, and that the box is empty. C did not see the act and has no opinion in the matter. The conclusions which these men will form will depend upon their previous experiences, their opportunities for observation and their native ability. Their *confidence* in their conclusions is not necessarily dependent upon the real facts. Or, to take another case cited by Jevons: "A steamer is missing, and certain workmen in a dock-yard, knowing that she is poorly built, believe she is lost. The public is informed that she is well built,


№ 1
40
30
20
10
0
0 1 2 3 4 5 6 Black
6 5 4 3 2 1 0 White
№ 2
100
90
80
70
60
50
40
30
20
10
0
8 6 4 2 0 2 4 6 8
− +
№ 3
30
20
10
0
60 66 72 78 84 90 96 100
№ 4
160
140
120
100
80
60
40
20
60 64 68 72 76
62 66 70 74
№ 5
16
14
12
10
8
6
4
2
1 3 5 7 9 11
№ 6
130
120
110
100
90
80
70
60
50
40
30
20
10
0
14 16 18 20 22 24 26 28 30 32 34 36 38 40

and is probably safe, although delayed. In the event itself there is no uncertainty. The vessel has either sunk or not. Nevertheless the probabilities will vary with different persons, and in the same person from day to day, as information is received in regard to storms at sea, signs of wreck picked up, the trustworthiness of her officers, etc." Finally after all have united in believing the vessel lost, she sails into port. While the general opinion is still the same, a few on land *know* that she is safe. Those on the vessel have never been in doubt about it.

In order to understand more clearly the application and importance of the Theory of Probability, let us take a single example:

Let us suppose that we have an urn, containing a large number of equal balls, and for simplicity, let us suppose that half are white, the others black. Draw from the urn any number of balls at once, say six, (of course without choosing) and repeat this drawing a large number of times (say 1,000) replacing the balls and shaking them up each time. Set down each time the number of white balls drawn. There are seven possible chances, viz:

6	white	and	0	black.	
5	"	"	1	"	
4	"	"	2	"	
3	"	"	3	"	
2	"	"	4	"	
1	"	"	5	"	
0	"	"	6	"	

We all know something in regard to the probability in each of these cases. We should meet least frequently with the two extreme cases—all white and all black—and in the long run we should meet with one as many times as with the other, since there is nothing in color or lack of color which could affect the chances in drawing.

The following table gives the distribution of the number of draws out of 100 for each of the possible cases. The greater the number of draws, the more nearly these values would be obtained:

Chances.				No. of Times.
6	White.	0	Black.	2
5	"	1	"	3
4	"	2	"	27
3	"	3	"	36
2	"	4	"	27
1	"	5	"	3
0	"	6	"	2
				100

That is, we should draw 6 white balls twice out of each hundred draws, etc. These numbers can be quite accurately determined by 1,000 draws, if the urn contain several hundred balls *

*These numbers represent the successive terms of the expanded binomial ($\frac{1}{2}$ plus $\frac{1}{2}$)^6 where the sum of the terms is taken as 100, and where the exponent represents the number of balls drawn at once.

XUM

In order to represent these chances to the eye, divide the horizontal line of Fig. 1 into six equal parts, laying off at right angles to it, and at the points of division, the vertical lines whose lengths are proportional to the number of draws for the various cases. The fact that the continuous curve passed through the extremities of these vertical lines, is symmetric on each side of the middle, means that white balls and black balls stand an equal chance of being drawn. If the black balls were less in number or were smaller, and had a tendency to sink to the bottom, then the curve would be unsymmetric, the probability being in favor of the white balls.*

We come now to the application of what we have here learned.

If any dimension—for instance the length of an iron rod—be measured with the greatest attainable accuracy, the successive measurements will, in general, all disagree. Taking a great many such measurements, all differing from each other, which shall we adopt as the true value? We may assume that all the observations are made with equal care; one can have no preference over another. The fact that they all disagree, and that the tendency to disagree increases with the delicacy of the determination, is sufficient to show that no one observation can be adopted as the true value; and further, that it is impossible for us ever to determine the true value. The best that we can do is to take the mean of all determinations. To this mean we give greater or less weight, according as the separate determination more or less nearly approximates to the mean.

In order to illustrate this point we may take the 470 determinations of the right ascension of the star Sirius, as made by the astronomer Bradley. In the following table d represents the difference between the observation and the mean of all observations (in tenths of a second); n represents the number of times the respective differences were found to occur.

The positive and negative distances are thrown together without regard to sign:

d.	n.
1	94
2	88
3	78
4	58
5	51
6	36
7	26
8	14
9	10
10	7
11 and over	8

i. e., out of 470 observations, 94 showed differences of less than 1-10 second, 88 fell between 1-10 and 2-10, etc. As was to have been expected, the greater

*In this case the terms of the binomial would be no longer equal.

"errors" are met less frequently than the smaller ones. The results are represented in Fig. 2 of the plate where the values (d) are laid off on the horizontal line and estimated from the point marked zero (o).

The line o 2 represents a certain positive "error," and the distance from 2 to the curve represents the number of times it is met in 100 observations. o 2 in in the opposite direction represents an equal negative "error," while the vertical line at the point 2 represents its frequency. It can here be observed how the frequency diminishes, as the magnitude of the error increases, until finally the curve intersects the base line, indicating that larger "errors" do not occur.*

The law expressing the divergence of these values from the mean is the same as that which expresses the probability in drawing balls from an urn containing an equal number of white and black balls.

In the case supposed, the differences are due to imperfections in the instruments and in the observer, to unknown variations in temperature, etc.

Let us consider another case, which will perhaps aid us in gaining a clear idea of the subject. Let us suppose that we have a rifle mounted like a swivel-gun, so that it can turn only in a horizontal plane. In the same plane let a thin, hard board be placed with its edge turned toward the gun If we fire at a certain point in the edge of the board, a sufficient number of times, we should cut into the board a gap which would be bounded by a curve precisely like the one before given. In case of a good marksman, the gap would be narrow and deep. (Fig. 3.) With an equal number of shots a very bad marksman would cut out a wide and shallow curve, while if all kinds of people were allowed to try their skill, we should get the curve of average human marksmanship. The errors of the former case are here represented by deviations from the mark, small deviations being most common. It might be said that these deviations are caused by chance. They are in fact the result of unknown but purely mechanical causes, such as gusts of wind, irregularities of the balls, fouling of the gun, or deviations caused by pulling the trigger. Chance is neither a thing nor a cause; it is simply a name to cover over ignorance of the real causes; it is a matter of experience, that a great number of simultaneously acting and constantly varying causes, affect the result in such a regular way that we can predict in a statistical way, the frequency of different errors or deviations. When these causes are unknown, we say that it is a matter of chance.

A curve of this kind would at once exhibit the success of any person in shooting at a mark, and it seems probable that the success with which we accomplish any other thing involving a great number of acts, would be represented by a similar curve.

We have a large class of people in this world who aim to be as good as other people. Some of them resemble the good marksman. Their deeds all lie very close to the mark. They are never very good and never very bad; but always "indifferent honest." Others are like wild shooters. If we could grade their acts, we should find some decidedly bad, others far above the average of good

*As the mean value is not the true value, it is not strictly correct to call these differences "errors."

ness, while a greater number would be ranked about average. The shallow curve of the bad marksman is suggested. The two cases are, however, not exactly alike, for a good shot is one which lies nearest to the mark, while the virtue of an act is judged by a higher standard than the supposed mark. Hence the marksman would always aim at the mark, while the man who wishes to be as good as other people, usually tries to make sure of having enough of good deeds by putting in a few extra good ones toward the last—that is, he changes his aim somewhat in order to polish up his curve into satisfactory shape.

That this same law of probability applies to the distribution of mental ability in a mass of people is well known. Comparatively few people are brilliant and comparatively few are stupid (the opportunities being supposed equal). The great majority of people rank near the average. Among others, Professor Hinrichs has investigated this subject, by a comparison of class markings at the State University of Iowa. The results here given are from the markings of the Freshman class in Physics.

The results are obtained by combining independent markings for recitation, notes on lectures, and laboratory work, as determined by three different instructors. The greatest pains were taken to secure just markings, the valuations being repeated several times. The best students were marked 100, and below 65 was counted a failure

In the following table the numbers are grouped in fives, 90 per cent. including 88 to 92, inclusive, etc.

The total number of students in the class was 287, and the results agree as closely with the theoretical values as would those obtained by making 287 draws from an urn containing black and white balls in equal number:

Standing	100	96	90	84	78	72	66	60	Total.
Number of Students	13	53	57	80	45	24	12	3	287
No. per 100	4.5	18.5	19.9	28.0	15.7	8.4	4.2	1.0	100

This shows that the chances that the standing of a student will fall in the group marked 84, is 80-287 or 28-100, or a little less than one-third. This is the grade of the average student, and here the greater number are ranked. For higher or lower markings, the number of students is less, the fewest numbers being at the extremes of excellence. It will be observed that in this case the numbers are not quite the same for grades equally removed from 80 per cent., the probability being somewhat in favor of the higher markings. This might possibly be different if a greater number of cases were examined. It is also to be remembered that such students are a selected class of society, and if all of the young people of a state were to be thus examined, the grade would probably be somewhat lower, and the numbers would perhaps show a more symmetrical arrangement.

We have previously discussed the mental divergence of men from the norma or average man. As might be expected, the same law holds in regard to physical dimensions, as was first shown by Quetelet.

For any given nation at any given time, there is a certain typical or average man, whose dimensions could be obtained by taking the average dimensions of all the men of the nation. Mr. Galton has even shown us how to obtain his photograph.* This is done by taking photographs of a large number of men, making the photographs of the proper size relatively, and taken in similar positions, although no great exactness is necessary.

Each photograph is then exposed to the camera in such a way that all the faces are re-photographed successively on a common plate. The best method of doing this, is to pin the first photograph to a block which can be set up in front of the camera. Its position there is fixed by nails driven into the base board, so that the block may be removed andre placed in exactly the same position. In order that the next picture may be exposed in the same way, an ivory or wooden scale, with a beveled edge, is placed with its edge tangent to the iris of the eyes, and with any division of the scale bisecting the nose. The position of the ruler is then fixed by guide nails or pins, driven into the block. This enables each photograph to be placed in the same position on the block, and the block to be always placed in the same position before the camera.

Each portrait is then exposed for a few seconds to the same plate, so that when it is finally developed a generalized picture is obtained.

It is not a portrait of any one person; it represents a type, in which those points which are common, are emphasized, and the purely individual peculiarities are almost wholly suppressed. The greater the number of component pictures the more truly will the resulting composite picture represent a type. We present here a composite picture from three criminals. It is from a wood cut in Mr. Galton's paper. As Mr. Galton remarks, "the villainous irregularities of the originals have disappeared, and the common humanity that underlies them has prevailed. This picture represents then, not so much the criminal, as the man who is liable to commit crime." [Portraits of nine members of the university faculty were also shown, together with the results obtained, by combining them in various groups.] It is evident that this work of Mr. Galton is an immense step in the study of race characteristics, and as has been suggested by him, it will be of immense service to art in enabling artists to study various types of beauty.

These portraits are shown here to aid you in forming a definite idea of what is meant by an average or typical man.

If, however, we wish to get the *dimensions* of the average man, we must resort to physical measurements. In this way it was determined that the height of the American soldier is 68 inches; his chest measurement is 35 inches, etc. These determinations were derived from the measurements of 26,000 soldiers of the Union army. The greater number of the men approximate the mean height, the number taller and shorter diminishing with great regularity to the dwarfs of 5 feet, and the giants of 6 feet 4 inches.

*Nature, Vol. 13, p. 95.

XUM

The number of persons in each 1000, of the various intermediate heights, is given in the following table:*

H	60	61	62	63	64	65	66	67	68
N	1	1	2	20	48	75	117	134	157

69	70	71	72	73	74	75	76
140	121	80	57	26	13	5	2

The numbers here are the same as we should get in the various chances in drawing 30 balls from an urn, containing an equal number of white and black.

The curve (See Fig. 4) representing the above observations, is the same as that which might be made by a marksman in shooting at a mark. If we were to determine the heights of all the men in a nation for each year of life, we should get a very interesting series of curves. Take all male children of one year of age; they differ comparatively little in height, or in mental power. They all approximate closely to the average. If we were to calculate the divergence from the average for 1000 cases, we should get a curve resembling the curve of an accurate marksman. It would be deep and narrow. Examining children of greater ages, say 10 years, we should find that they have begun to diverge from each other. Circumstances have arrested the development of some, and have caused others to surpass the average. In 1000 cases we shall therefore have a less number of persons of average dimensions.

The curve for this case would be like that formed by a poor marksman, the curve becoming more and more shallow, as we come to higher ages.

If we could grade the various members of society according to their opinions upon any subject which agitates the whole of society, we should find some such distribution as the one just examined. We should find two extreme parties, (corresponding to the dwarfs and giants of the previous case) comparatively few in numbers, but active, resolute, aggressive. Between, we have the great mass of respectable society, interested in other things, and giving little real thought to the matter; anxious to hold proper views, and therefore holding average views as the safest; pulled upon by the opposing workers, and yielding slowly to the resultant force, and thus, by reason of its immense mass, securing comparative stability and order against the rough jostlings of the more active, but less ponderous extremes.

According to the investigations of Horstman, Hinrichs and others, the velocity of chemical reactions in time, is represented by this law. It has been proved theoretically in some cases, and experiment has confirmed the conclusion.

If we throw small fragments of zinc into sulphuric acid, we get an evolution of hydrogen gas. At first the velocity of evolution is very small; it increases, however, and finally reaches a maximum. Thereafter the velocity diminishes

*Quetelet—Anthopoimetrie, p. 252.

until it finally ceases. Fig. 5 represents an actual experiment. The time in minutes is laid off on the horizontal line, while the velocity of evolution of the gas at various moments is represented by the distances from the base line to the curve. Hinrichs has shown from the experiments of Guldberg and Wage, that the probability curve represents this case very closely. Operations based upon heat conform more closely to this law, as there all the particles have a more equal chance of being acted upon—an essential condition. In society there are manifold operations which closely resemble this. Almost every year society is agitated by some idea, which at first interests very few people, but the interest gradually grows, and apparently with considerable regularity, reaching finally a culminating point, and then gradually dying out. The base-ball and blue-glass fever and the zig-zag puzzle may be mentioned as cases of this kind, and other cases will readily suggest themselves. Movements in society which are properly classed as reforms, usually make slow progress at first. The case is, however, advocated by a few tireless enthusiasts, like Wm. Lloyd Garrison, and after dragging along for years, the matter suddenly makes rapid progress, and is abruptly settled.

In other movements of less momen, tlike the adoption of some fashion in dress, the matter makes great headway at first, rapidly receiving the assent and adoption of the great mass of people, a few laggards bringing up the rear.

These cases, which are symmetrically related to each other, would be represented by the chances in drawing balls from an urn containing unequal numbers of white and black balls.

Another well-known case lies at the base of all life insurance. We can predict with great confidence how many persons out of 1000 who are 10, 20, 30 or 40 years of age will live through the next year. This case is so well known, that we will discuss a somewhat more interesting one, which has been investigated by Dr. Granville. I refer to the probability of marriage. Dr. Granville determined in some manner the age at which 876 English women were married. The values thus determined are given in the following table, where the number marrying at the various ages from 13 to 40 is given:

Age.	13	14	15	16	17	18	19	20	21	22	23	24	25
No.	3	11	16	43	45	76	115	118	86	85	59	53	36

Age.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	. .
No.	24	28	22	17	9	7	5	7	5	2	0	2	0	1	0	. .

From such values, extended to a greater number of cases, we might easily deduce the probability of marriage at various ages. In this table, those who do not marry at all, are not included. These facts are represented in Fig. 6 of the plate.

This operation reminds us very strongly of the chemical re-action. The hydrogen is liberated, at first slowly, the velocity increasing for a time, and gradually diminishing to zero. If we consider the velocity of marriage, the same

general relation exists. Starting with 1000 young ladies at 13 years of age, three of the young ladies marry during this year. The velocity of marriage increases until during the 19th year the number is 131, the maximum velocity of 134 per year being reached at 20. Half of them are now married, and from this time these interesting creatures drop off much less rapidly. At the age of 30, only 10 out of 1000 marry, while at the age of 40, the chances for a *first* marriage are practically gone. Those who have had previous experiences of this kind might perhaps manage to make some arrangement even then.

It will be observed that the chances do not diminish symmetrically on opposite sides of the maximum. In the operation of drawing balls, this would be represented by the case where the number of white balls was say greater than the number of black, making the probabilities less in drawing black.

We are thus able to calculate how many times out of 100 draws we shall draw all white balls from an urn, but we cannot predict what will be the result of any particular draw. We can predict how many times in 100 measurements a person will make an error of a thousandth of an inch, but we cannot predict what the error will be in any particular case. We can predict how many shots a certain marksman will put into a circle two inches in diameter, but we cannot predict where any one shot will strike. In a class of sufficient dimensions we may be able to predict how many will have mental ability enough to reach a mark of 90 per cent., but we cannot discuss the infinite number of subtile influences that have been acting on any one person, giving to each its proper weight; we cannot repeat the same thing for his ancestors, tracing back from him through the centuries the numberless divergent threads of inherited tendencies, and thus give a complete reason for the ability and inclination to learn, which any given student manifests. We cannot tell why any person varies an inch in height from the average of his kind; nor can we give a complete reason for similar divergencies in moral stature. Quetelet has shown that we can predict how many men will commit murder or suicide in Paris during a year, but we cannot discuss the matter in such a way as to enable us to predict who the unfortunates will be, at what moment they will decide to commit the fatal act, and exactly what they severally lacked, mentally or physically, the possession of which would have changed their decision.

But we can imagine a being, who shall be mentally able to do all this; to give a complete solution of any problem that the human mind can propose. The causes for the breaking down of a railroad bridge can be given by a competent engineer, and he may be able to detect the weak points in the theory of its construction: he may be able to guard in part against flaws in the material. In the same way, and in a much more perfect manner, an infinite mind could discuss the breaking down of a human resolution, under the strain of temptation, and could give a precise reason for the physical, mental, or moral divergence of any given man, from the average man.

XUM

The equations involved in this discussion must be sufficiently comprehensive to include the surroundings of each man, as well as the man himself. The decis ion a man will reach, by reason of all influences brought to bear on him, depends upon the *man*, and upon the *intensity* of *the influence*, just as the interaction between two planets depends upon *both* of the acting bodies. That is to say, in the equations there will appear certain constants the values of which will differ with different men, just as in building a bridge, the values of certain constants in the formulæ depend upon the kind of material used. In the former case the value of these constants will be determined by the previous experiences of the man upon his inherited ability, tendencies, etc. We recognize all this in the popular saying, that different men under the same influences act differently, just as different beams of wood under a given tension, would act differently. Some would safely carry a load under which others would break down at once. The values of these constants may change for the same man, as when experience in any emergency causes him to resolve to do differently next time.

Our equations must then enable an infinite mind to trace out, in such a manner that they could be predicted, all such events in the life history of a man as these: On a certain day and hour he will decide to take a pleasure walk, influenced by motives which we need not consider. Passing near the river bank, he sees a fellow-man struggling in the water. At once various mental forces are brought into action. He has, during his whole life, found pleasure in deeds of benevolence. For this trait in his character there is an adequate cause, but we need not consider it. His first impulse is to rush in and save the drowning man. The fact that he is an expert swimmer tends to influence him in the same direction. But he also knows that his lungs are in feeble condition, and, moreover, he is overheated by vigorous walking, he is far from help, and the water and air are cold. The drowning man is strong, and thoroughly frightened. The events press for an immediate decision, and this may also have its influence in determining what the final decision will be. Some of us think that a higher power may also influence him in some way. All these influences, brought to bear on this man's mind, resemble a system of parallel and opposing forces acting upon a particle of matter, only, the relative *magnitude* of these forces will be different, for different men. As in the one case there will be a certain resultant, in the direction of which the mass will move, so in the other case, there will be a resultant—a decision, which will bring about a corresponding line of action. For a time, his judgment may hold him in equilibrium, as previous experience causes him to act with prudence. The discovery that the drowning man is his son, would probably determine his decision at once, and the discovery of a rope upon the bank, would attach upon his mind another intensely acting force. During his moments of suspense, the intensity of these forces would be constantly varying, as one after another consideration presents itself for the moment prominently in his mind. The infinite mind, fully learned in mathematics and mental philosophy, could predict at what moment the man would decide to rush in, and by continuing the

calculation, might find that as a result, his respiration and circulation would be affected in a certain way, a large secretion would form in his lungs, and that at a certain moment, in a fit of coughing, it is calculated that a certain point in one of the large blood vessels would be strained a few grains more than it would be able to endure, resulting in its rupture.

In the region over which we have now been traveling, all questions of probability have vanished. Everything has become certain. In a world full of such minds, many kinds of business—as life insurance—could not be carried on, as the individual risks would be perfectly known.

Our reasoning is all based on the assumption, that all events, whether in the world of matter or of mind, are preceded by events which may be taken as *direct and adequate causes.* Even when a man willfully decides to do an unwise and an unreasonable thing, there is a cause for it, and the existence of the effect is of itself sufficient evidence of the sufficiency of the cause. That is, there must be some reason why a man decides against reason. A rule which seems to be quite general is, that in any given case (so far as reasonable motives enter into consideration) we decide to do that which we then think will give us on the whole most pleasure or least pain, often deciding, however, to give up a greater pleasure, to be enjoyed only in the future, for a lesser one, to be enjoyed immediately, precisely as we sometimes allow a note to be discounted, in order that we may realize upon it at once. The actions may in many cases be unaccompanied with any elaborate reasoning, and may be without special reference to consequences, as when in consequence of previous reasoning of himself, or his ancestors, a man may form the *habit* of doing certain things. In such cases the action seems to be largely automatic. A man's ideas of pleasure may be very low and vulgar, he may possess very poor judgment, and foolishly discount his happiness for too high a per cent., and the question arises then, why is he so? We cannot answer, except in general terms. He has inherited certain peculiarities, certain tendencies. He may have been placed in surroundings not favorable to mental and moral growth, and one of these inherited peculiarities may be the lack of a *desire* to cultivate his finer feelings, just as others may evince a lack of desire to cultivate mathematics, or music, or chemistry. Even when placed under the most favorable auspices, the mathematician, the musician, the chemist or the moralist, fail to arouse in him the least sign of appreciation. The lack of appreciation is fatal to success in mathematics; why should it not be equally fatal in morals? Precisely what it is that such men lack, whether it be merely a matter of nerve tissue, or whether something infinitely deeper is involved, is a problem, the complete solution of which is merely a matter of ability.

The fact that our most earnest thinkers on such subjects come to such widely different conclusions, makes it probable that we are all incapable of dealing with the subject in any exact manner. Whatever we may think of ourselves, and our reasonings, we are probably all one-sided, and take altogether narrow and incomplete views of the subject.

The difficulty of reaching precise results is increased by the impossibility of our making precise measurements of the influences about which we are talking.

A person of rather limited information, who might happen to observe that his butcher is sending him less and less beef for a quarter of a dollar, and who might incidentally learn that the earth's mass is being constantly increased by the fall of meteoric matter upon its surface, might possibly argue that this apparent rise in beef is due to the fact that it requires less beef to pull the index of the spring-balance down to the one pound mark. The reasoning is perfectly correct, but when we come to measure the *intensity* of the influence it is found entirely insignificant. Such a person would need to learn that there are many other potent influences that affect the price of beef.

So in the difficult subjects which we have been discussing.

There may be secret springs in the human mechanism of which we are all wholly ignorant, and we may attach undue importance to many influcnces. However this may be, it seems to me possible to imagine beings of a higher order of intelligence, having perfect knowledge of men physically, mentally, morally and spiritually, and capable of predicting all our future surroundings, and all our future decisions. Of course this has nothing whatever to do with the *nature* of mental or spiritual operations. We may agree that they are as unlike "merely mechanical" operations as we please. The infinite Being, particularly if He be assumed to be a Creator, can trace out the future of a man with much greater precision than a "mere" manufacturer can trace out the future of a watch. Although the latter may be able to predict approximately what his watch will do, *if properly treated*, he cannot know how it will be treated. With infinitely greater precision an infinite mind could trace out the totally different class of phenomena, known as spiritual and mental operations. He would know that at a certain moment some one of us will be surrounded with peculiar dangers and temptation; he would know whether the man will be able to deliver himself without external aid, (from either a human or a superhuman source) and he would know whether or not this aid will be given, and the precise effect which it will produce. If there are beings who *know* the future orbits of men, as astromomers know approximately the future orbits of planets, the question at once arises, in what sense are men free to decide, as distinguished from the freedom of a planet to move? If *any* being knows absolutely that an event will happen, seeing clearly *all* of the acting causes, is there a single possibility that it may not happen? Would not its failure to happen be taken as proof positive that there was no such knowledge as was assumed?

It is of course possible for me to decide to do a thing, *and* to decide not to do it, but it is not possbile to do these things simultaneously. They must come successively, and each decision would be determined by the mental forces before discussed. Each decision could be predicted. One of these forces might arise from a desire to avoid the conclusions which here seem to force themselves upon us, and lead to an attempt to exert the mind in a purely arbitrary manner.

This view of the matter is from the standpoint of perfect knowledge. From our standpoint we can only observe that men differ from each other in height, in weight, in mental or physical strength, in moral worth, and that they appear to group themselves in a definite way about the average man.

If we now attempt to grade men according to the wisdom which they exhibit in their choices, we should find comparatively few people exhibiting the highest forms of wisdom; the representatives of extreme foolishness would probably be more numerous. Between these extremes we should have all possible grades, in which the mass of society would be represented. It is hardly probable that the resulting curve would be symmetric. The greater chances would probably be in favor of foolishness, corresponding in the drawing of balls from an urn, to the case where the number of white balls is greater or less than the number of black. That is, from the human standpoint, the wisdom of human choice, in the aggregate, appears to be a matter of chance, in the same sense in which it is a matter of chance where shots will strike a target.

From the higher standpoint of perfect knowledge no element of chance can enter. Each choice, whether wise or foolish, whether the reasoning which has led to it be logical or not, is determined by perfectly definite causes, admitting of precise mathematical discussion.

In what way can we then justify the enforcement of law? The stability of society is here involved. Society has the right to protect itself against attack, and the greatest good to the greatest number demands that this right be exercised.

Some of us act as missionaries in elevating the aims and tastes of less fortunate men, in placing before them motives for a better life, *because*, all things considered, we prefer to do so. Many of us admire fine paintings, grand music, and generous, self-sacrificing deeds. This will ensure their perpetuation.

Those who, as a result of pre-existing causes, find themselves in the possession of a high appreciation of all that is pure and noble, will strive, more or less wisely, to surround others with influences which will draw (or push) them towards a higher life. A being sufficiently wise and powerful might at once solve our problem by at once removing all tendency to evil. Society must, however, settle the matter by a slower process—the process of education of head and heart—a process necessarily slow, and accomplished with infinite pain.

Even in so small a matter as the preparation of our food we have reached our present knowledge by painful degrees. Our rules for cooking, yet imperfect, have been reached through centuries of experiment, and at the expense of a countless number of sour stomachs and aching heads. So it has ever been in morals. Here we are all doubtless blundering experimenters, but we are gradually learning that some things are better than others, and the tendency is, slowly but irresistibly, toward a morality which is not only practiced but appreciated. In the meantime criminal law is the rude and only partially effective means for repressing those evil spirits, upon whom better influences have not chanced to act sufficiently.

If we add sulphuric acid to zinc the hydrogen does not all pass off at once; the process which follows requires *time* for its completion. So it is with the good leaven in society. The individuals are not all changed at once; those who chance to be most favorably situated are first changed. The whole process requires time, and in the meantime, urged on by our necessities, we have taken the responsibility of hanging some individuals, just as we kill obnoxious wolves and bears. So that for the present, notwithstanding all our efforts to better the condition of the poor, a large number of them will never have the opportunity to learn the instincts of gentlemen, and their senses will remain so blunted that they will not be able to realize, as we can realize, the utter wretchedness of their situation—a situation into which they are born, and from which, experience shows, the greater part of them cannot escape, even when they chance to possess the desire to escape. The misery of their condition is made yet deeper by the successful struggles of stronger and better men after *their* ideals of happiness.

It is difficult to see how an all-wise and an all-powerful Creator could have been the author of so much misery. But the other hypothesis that there has been no creation, that the universe is but the sporting-ground of irresponsible force, and that finite intelligence has been self-evolved from inanimate matter, seems equally incredible. In whatever way we view the matter this difficulty seems to me logically insurmountable, and I do not wonder that in the great poem of Milton, he describes the fallen spirits as deeply engaged in a hopeless controversy upon

> "Fixed fate, free-will foreknowledge absolute,
> And found no end, in wandering mazes lost."
>
> —Book II. (560-561.)

Happily for the business of life the irrepressible love and admiration of humanity for the pure and good saves rational men from practical error, or from rebelling against the eternal law, in which science and faith agree that although time and chance happen to all, yet that whatsoever a man soweth that shall he also reap; and in this fact that we believe that we shall be held responsible, the feeling of responsibility appears to find, at once, its explanation and its justification.

An insect which produces a species of India rubber has been recently discovered in the district of Yucatan, Central America, by an American explorer. It is called *neen*, and belongs to the Coccus family; feeds on the mango tree, and swarms in these regions. It is of considerable size, yellowish brown in color, and emits a peculiar oily odor. The body of the insect contains a large proportion of grease which is highly prized by the natives for applying to the skin, on account of its medicinal properties. When exposed to a great heat the lighter oils of the grease volatilize, leaving a tough wax, which resembles shellac, and may be used for making varnish or lacquer. When burned, this wax, it is said, produces a thick semi-fluid mass, like a solution of India rubber.

METEOROLOGY.

THE TORNADOES OF APRIL 18, 1880.

BY PROF. J. D. PARKER, KANSAS CITY.

Again the state of Missouri has been visited by a devastating tornado, which occurred April 18th, and again the phenomena and calamities of St. Charles in 1877 and Richmond in 1878 have been repeated. We observe sudden high temperature and low barometer, intense electrical activity and displays of enormous atmospheric force, with heavy loss of life and destruction of property. The aërial disturbance seems to have been very general over the western portion of the continent, from the Ohio valley to the Pacific coast and from the Lakes to the Gulf, but, so far as can be now ascertained, the most direct and well-marked line of destructive force extended from the Indian Territory, near the Arkansas River, northeastwardly, by way of Fort Smith and Fayetteville, Arkansas, Springfield, Marshfield, Russellville, Jefferson City, New Bloomfield, and Fulton, Mo., toward and to Jacksonville, Ills. Whether the other disturbances were from independent causes, or were offshoots of the same storm, is uncertain.

Besides the destruction of property and loss of hundreds of lives on this line at Marshfield, which is the county seat of Webster county, 215 miles southwest of St. Louis, on a plateau of the Ozark Mountains, though not particularly exposed by its elevation, great damage was done at Fayetteville, Arkansas, (though by an error, probably, the tornado is reported to have struck Marshfield and other points north and east of it several hours before it reached Fayetteville); also at Oak Bower, Ark., near the line between Arkansas and the Indian Territory, New Bloomfield, etc., all of which has been fully detailed by the daily papers.

On the same day, but in the morning, a fierce storm was raging in Kansas, the velocity of the wind at Lawrence reaching 80 miles an hour, the greatest ever recorded there. At Leavenworth the U. S. signal officer recorded 60 miles an hour, while at all neighboring points the fury of the storm was almost unprecedented. The barometer at the U. S. signal station at Leavenworth marked the greatest depression ever noted there, viz.: 29.04, corrected to sea level. The amount of sheet or "heat" lightning was so great in the western sky that many of the people of Leavenworth thought that Lawrence was on fire.

At this city the storm of Sunday morning was light compared with that of the evening, though throughout the whole day there was an alternation of wind, hail and rain storms, culminating in a gale at night which did some damage to roofs and fences. The maximum temperature was 82° and the minimum depression of the barometer 29.20.

It is almost impossible to indicate the paths of these storms from the data at hand, but the Signal service charts and reports, when fully made up, will doubtless give to the meteorologists some very remarkable information and suggestions.

The early appearance of tornadoes this year in this latitude seems to be exceptional. The equatorial wave of high temperature appears to have drawn them forward nearly a month. Tornadoes will occur whenever the conditions are supplied, and will of course appear earlier with premature heat.

I wish simply to call attention to the fact that the Marshfield tornado conforms as far as known to the physical laws as explained by the thermal theory. Prof. Tice, who holds to another theory, in his report of the tornado, says:

"Everywhere along the track of the tornado there is evidence of a wave of water flowing in the rear of the cloud spots. At some places there are only faint traces of such a wave; at others the debris is carried up and over obstructions of from two to three feet high. These waves or currents flowed in greatest volume up hill. There are places where the entire top soil is washed away by the currents. Fibrous roots and tufts of grass show their direction to have been up hill, and what is significant, from all points of the compass to the top of the hill where the tornado was raging at the time and expending its force. No trace can be found at any point where they flowed down hill. Many level places are swept clean of soil. Leaves, grass and debris of the wrecked buildings, fragments of plants carried along by the current and left in its track had arranged themselves longitudinally to the current."

This reported wave is evidently only the great condensation of vapor rushing from all directions into the core of the tornado.

Colonel R. T. Van Horn, in discussing the fact that tornadoes follow the isothermals, says:

"The cause is the meeting of two waves of air at different temperatures, and where should that meeting be more marked or the effects produced of as great intensity, as on the line that marks the mean between the two conditions? If there is a general law that governs in their origin and formation, there must be one that controls in their movements. And we have traced enough of them on the isothermal maps to be satisfied of the fact that their movement does correspond to these lines of mean temperature."

If tornadoes follow the lines of mean temperature must there not be some vital relation between them and heat? This is what is claimed by the thermal theory.

Electricity seems inadequate as the cause of the tornado or for the production of the fundamental movements. Why does electricity revolve the tornado north of the equator in the direction contrary to the hands of a watch, and south of the equator in an opposite direction? Why does electricity cause tornadoes to move along the lines of the isothermals northeasterly? Why do not some of them, even if only for variety, move in an opposite direction? True, light substances under a charged receiver will be attracted toward it to restore the equilibrium. But will electricity, as in a tornado in Georgia, carry up a tree,

XUM

sixty feet in length and two and a half feet in diameter, half a mile high, and then fling it out of the tornado to come crashing to the earth? Why did the tree ascend in a *spiral* path? And in the Camanche tornado of 1860, why did a man, and two horses in a reversed position, sail around on the opposite sides of a circle? Can electricity under its known laws produce such results? Possibly some one may yet discover a spiral kind of electricity, and show that zigzag lightning is only the transverse section of spiral electricity blazoned on the sky.

Forests present the most efficient safeguards against tornadoes. As long as cyclones can sweep unobstructed over our prairies we shall see the sudden destruction of villages and cities and the terrible loss of life and property. But forest countries present such obstacles to the translation of tornadoes on the surface that when one touches the earth it is soon driven into the upper air where it passes off comparatively harmless. Tornadoes are one of Nature's voices telling us in unmistakable tones to plant forests. Indeed abundant forests would free us from destructive winds, drouth and locusts, our three most serious physical evils. With abundant forests, inhabited by an enlightened people observing the moral law, our prairie world would become almost a paradise.

SCIENTIFIC MISCELLANY.

A NATURALIST'S RAMBLES ABOUT KANSAS CITY.

NO. I.

WM. H. R. LYKINS.

For the lover of Nature in all her forms there are few better localities for a ramble than the hills around our city. The botanist, the entomologist and the geologist can here find much to interest them, and add many good and not a few rare specimens to their several collections. And for the fortunate possessor of a *good* microscope there is a never-ending fund of instruction and amusement in the thousand forms of fresh water infusoria inhabiting the many mossy springs oozing out on the hill-sides. The Diatomaciæ are especially abundant, encrusting the rocks with their peculiar brown hue in places where the water streams over the cliffs. As we stand upon the top of the bluff fronting westward and look down at our feet we find the rocks strewn with fossil shells; and we can easily imagine the time when this was a wave washed shore and the vast expanse spread out before us was a region of shallow seas dotted with reefs and islets; once the homes of myriads of Mollusca, from the tiny *Cythere*, no bigger than a pin's head, to the great coiled and chambered shell of the *Nautilus*, thirty inches in diameter, whose fossilized remains go to make up these rocks. In these waters also roamed a great shark, the *Petalodus destructor*, doubtless the terror of these

seas, whose sharp triangular teeth we occasionally find here, being all that is left of their cartilaginous bodies.

Descending the hill, we come to the base of a cliff thirty feet in height. The rock is solid and close-grained, barren of fossils except here and there a crinoid stem or stray shell of an *Athyris*, showing that it was formed in a still, quiet sea too deep for animal life, and we pause to think how many thousands of years it took to form this one bed, if it is true, as geologists suppose, that these rocks were formed by the slow deposition of sediment washed from the ancient shores, settling down at the rate of a few inches in a century. Yet this one bed is no more in the carboniferous formation alone than a single leaf in Webster's Great Unabridged, compared with the whole volume. This cliff rests upon another bed of limestone formed under different conditions. It is an impure shaly limestone, bedded in irregular wave-like layers, showing that it was deposited in a shallow, muddy sea under the influence of a strong current. It has but few fossils except in the upper part, where there are many of the lace-like skeletons of a species of coral (*Fenestella*). And so each stratum of rock or shale tells its own history to the experienced eye of the geologist as he passes along.

Next below this is a bed of shale about fifteen feet in thickness. It is entirely destitute of fossils except a thin seam about two inches in thickness near the center, which is one mass of the stems and plates of crinoids (stone lilies) and other fossils peculiar to the carboniferous. Here, under favorable conditions, an animal life suddenly sprang into existence, grew and flourished for a while, and as suddenly perished. This place has yielded many beautiful fossils to the collector, *crinoids*, *Edmondia*, *Euomphalos*, *Hemipronites*, *Bellerophon percarinata*, &c., all in a fine state of preservation. Here was found an almost perfect specimen of the head of *Zeacrinus Mucrospinus*, a crinoid, and the only perfect one ever found anywhere, so far as we know. In a little pool of water at the bottom of this bed of shale we found our first *Rotifer Vulgaris*, or wheel animalcule, after having long sought for it in vain in other localities. Marvelous tales have been told of the tenacity of life in this little animal, especially by the Abbe Fontana, who wrote a celebrated work on the Poison of the Viper. It was claimed that it could be boiled, baked and dried for an indefinite time, and then resuscitated with a drop of water. The savants fought long and bitterly with their accustomed acrimony and tenacity over this question, and finally left off where they began, neither side being convinced. All that we ever found perished on the slide as suddenly as any of their species, when deprived of moisture. They are, however, a most beautiful and wonderful object under the microscope at all times, and well worth the trouble it sometimes takes to find them. Their brilliant and crystalline structure allows the inspection of their inner formation, and they will kindly feed on indigo, vermilion or any other coloring matter and make curious and interesting spectacles of themselves. Often they can be found in almost any puddle of water, and again we may hunt a whole season for them and not find one—at least such has been our experience.

XUM

A little farther down we come upon a clump of *Asclepia tuberosa*, their scarlet blossoms blazing like torches set upon the hill-side. The root of this plant is much sought after by old-fashioned country doctors, who consider it a "powerful remedy" for coughs, colds and diseases of the lungs. It has many common names, such as Canada root, white root, pleurisy root, &c. It is naturally an inhabitant of the prairies, but is often found growing in the woods, the only difference being in the stalks, which here rise more tall and slender owing to the more confined space in which they grow. The root is essentially the same. Many plants which grow almost exclusively on the prairies are found in the open places on the west side of these hills, such as the prairie sunflower and compass plant. The seeds, no doubt, having been brought by the prevailing west winds, lodge here and flourish, contented exiles from their native homes. There is often an interesting mixture of wild and cultivated plants, the latter being probably from stray seed from the old gardens of the early French settlers.

At the foot of a little ledge of rocks we find a pile of the dismembered limbs of the red-legged grasshopper (that bandit from Colorado, famous for its ravages in Kansas), which looks curiously like the remains of a miniature cannibal feast. We have not far to go to find the Ogre; he is at home in his cave, or crevice in the rock, a great bloated, black spider, so gorged with the juices of his victims that he can scarcely move, and we easily transfer him to a bottle and send him on a long journey to a scientific gentleman in Massachusetts. These warm, sunny slopes are favorite places for spiders, and collectors of the *arachnidae* can find many different species. There is also found here a most gorgeous beetle, whose name we do not know. It is about half an inch in length, of a slender shape, beautifully striped in green and gold, with purple legs. It is not plentiful, but can occasionally be found in bare sandy places, running about in the warm sunshine.

One of the most interesting stratum of rocks in our hills is the Oölite, a granular limestone formed of small round grains, having the appearance of petrified fish roe, and takes its name from *Oon*, a Greek word for egg. It is a fine building stone, easily dressed, and was much used in early times in our city. In places it yields beautiful fossils, especially a large *Pleurotomaria*, a coiled conical shell. Its striated surface, of a rich chestnut brown, having the appearance of being newly varnished, will vie in beauty with many a recent shell fresh from the sea-shore, and make a collector's eyes turn green with envy. The fish remains found in our rocks are principally teeth, of many species, in excellent condition. The bed, however, which has afforded the greatest variety of fossils to our collectors is found at the extreme foot of the hills. Its upper part is a layer of shale, passing into a black, flinty stone, which rests upon a fine-grained, dark gray limestone. In many places this layer of shale is one mass of fern-leaves, of several species, but principally a species of *Pecopteris*. In other places the jointed stems of an aquatic plant of the rush family, takes the place of the ferns. A curious and interesting object is the fossil shells of several species of animals, which lived on

these water plants, still adhering to the stems. This bed from top to bottom is the richest field for the collector, and has furnished our cabinets with many splendid specimens of *Nautilus*, *Orthoceras*, *Goniatiles*, *Euomphalos*, *Allorisma*, *Pinna*, *Phillipsia*—in fact, nearly everything that is usually found in the Upper Carboniferous of Missouri. It is particularly rich in Nautili, and some of the cabinets in our city contain magnificent specimens of a half a dozen different varieties, some not described or figured by any of our Paleontologists. In the different collections made in this city are to be found many fossils from our hills not named or described in any of the State Reports or books on this subject, and we believe it would well repay some good Paleontologist, like the late Prof. Meek, to visit this city and examine the fossils of this locality.

We have arrived at the foot of the hill, but have glanced at only a few of the many objects of interest to be found as we strayed along. But, alas, these pleasant "rambles" are fast disappearing under the "building hand of man." Soon stately piles of brick and marble and busy streets will cover the places where we once held pleasant converse with nature, studied the pages of her book and pried into her secrets, and those who have a love for such things should improve the present opportunity to enjoy that most healthful and instructive of recreations—a ramble on the hills.

(*To be Continued.*)

THE CURIOUS INFLUENCE OF ELECTRIC LIGHT UPON VEGETATION.

At the meeting of the Royal Society last evening (March 4th) Dr. C. W. Siemens, F. R. S., gave a detailed description of some experiments upon the above subject which have been conducted during the last two months at his house at Sherwood, and exhibited specimens. The method pursued was to plant quick-growing seeds and plants, such as mustard, carrots, swedes, beans, cucumbers, and melons, in pots, and these pots were divided into four groups, one of which was kept entirely in the dark, one was exposed to the electric light only, one to the influence of daylight only, and one to daylight and electric light in succession. The electric light was applied for six hours each evening—from 5 to 11—and the plants were then left in darkness during the remainder of the night. The general result was that the plants kept entirely in the dark soon died; those exposed to electric light only or to daylight only throve about equally; and those exposed to both day and electric light throve far better than either, the specimens of mustard and of carrots exhibited to the society showing this difference in a very remarkable way.

Dr. Siemens only considers himself as yet on the threshold of the investigation, but thinks the experiments already made are sufficient to justify the following conclusions: 1. That electric light is efficacious in producing chlorophyl in the

leaves of plants and in promoting growth. 2. That an electric center of light equal to 1,400 candles placed at a distance of two meters from growing plants appeared to be equal in effect to average daylight at this season of the year; but that more economical effects can be obtained by more powerful light centers. 3. That the carbonic acid and nitrogenous compounds generated in diminutive quantities in the electric arc produce no sensible deleterious effects upon plants inclosed in the same space. 4. That plants do not appear to require a period of rest during the twenty-four hours of the day, but make increased and vigorous progress if subjected during daytime to sunlight and during the night to electric light. 5. That the radiation of heat from powerful electric arcs can be made available to counteract the effect of night frost, and is likely to promote the setting and ripening of fruit in the open air. 6. That while under the influence of electric light plants can sustain increased stove heat without collapsing a circumstance favorable to forcing by electric light. 7. That the expense of electric horticulture depends mainly upon the cost of mechanical energy, and is very moderate where natural sources of such energy, such as waterfalls, can be made available.

Before concluding his observations, Dr. Siemens placed a pot of budding tulips in the full brightness of an electric lamp in the meeting-room, and in about forty minutes the buds had expanded into full bloom.

THE SECOND HOWGATE EXPEDITION.

Captain Howgate's bill having passed the House, active preparations are being made for the start of the expedition, which is fixed for the 15th of May. The Gulnare, a steamer of about 200 tons, is lying at Alexandria, Va., being strengthened and thoroughly refitted for the voyage under the experienced direction of Captain Chester. It is expected that the vessel will be ready in a fortnight. She will start from Washington, fully manned and equipped, with two years' supplies. The members of the expedition number about twenty-five, including a corps of scientific observers. Touching at various points on the coasts of Labrador and Greenland, the expedition will proceed to the west coast of Smith's Sound at latitude 81 degrees and 40 minutes, where the first permanent depot will be made. Landing the men and supplies, the vessel will return in the fall. The general features of Captain Howgate's plan of operations are too well known to require explanation. He proposes to reach the Pole, if possible, by a system of slow but continuous advances, made during several successive seasons, pushing his camps farther and farther northward as rapidly as may be found practicable, establishing a secure basis of supplies and replacing men, who may become disabled or disheartened, with fresh recruits each year. Though this necessarily involves a large outlay of means and may perhaps cost some sacrifice of life, it will prove in the event of success the least expensive and most humane method of accomplishing the result. To lay siege to the desired goal in this systematic and persistent man-

ner is to put a stop to the desultory and ineffectual attempts thus far made by the several nations which have so earnestly striven to carry off the prize. The Captain finds no difficulty in securing men to undertake the enterprise; his funds are ample, and he is sanguine of the success which he certainly deserves after so many years of constant effort.

The Hon. J. R. McPherson, chairman of the Senate Committee on Naval affairs and Hon. W. C. Whitthorne, chairman of the House Committee on Naval affairs are entitled to the thanks of all friends of science and exploration throughout the world for their persistent and successful advocacy of this measure.—[Ed.

WATER-SPOUTS OFF KAUAI.

On Monday, the 9th of March, there was a fine exhibition of water-spouts off the eastern coast of Kauai. When first seen just after light in the morning there were two in company. They were tall, straight and symmetrical, and as alike as two peas, extending like pillars from the ocean to the sharply-defined lower edge of a black cloud, from which was precipitated at quite a distance in the rear of the water-spouts a heavy shower of rain. To the rear again of the shower there was at frequent intervals seen the quick flash of electricity as it leaped from the cloud to the briny abyss.. The whole procession was passing majestically toward the south, some ten miles out to sea, in a direction nearly parallel with the coast. One peculiarity which added to the interest of the spectacle was the slow revolution of one of the water-spouts around its mate, describing an orbit perhaps two thousand feet, or even more, in diameter. After a time the two water-spouts faded away and disappeared, and presently after a lapse of several minutes a third one was seen to be forming. The whirling base of mist on the sea and a descending cone of cloud appeared simultaneously, and soon became connected and developed into a perfect column.—*Hawaiian Gazette.*

MOSAICULTURE.

M. Chretian (writes our Lyons contemporary) has this year given us in the Parc de la Tete d'Or, some pretty examples of what he terms "mosaiculture," in the shape of beds containing mottoes and devices set out with colored foliage plants. Our Scottish neighbors seem to have carried the idea farther, with an eye to business as well as ornament. On a hillside not far from Glasgow may be read the words *Glasgow News* in gigantic letters, each forty feet long and six feet broad, formed of colored foliage plants. This inscription occupies a length of one hundred yards, and covers a space just 1,450 times the size of the Journal it advertises.—*Garden.*

OBITUARY.

SKETCH OF THE LIFE OF PROF. W. K. KEDZIE.

Prof. William K. Kedzie, who was known to many of our readers as former Professor of Chemistry at the Kansas Agricultural College, and who will be remembered by hundreds of the citizens of this city as having delivered a memorable address at the Commencement Exercises of the Kansas City College of Physicians and Surgeons in 1877, died at Lansing, Michigan, of typhoid fever, on the 14th of April. He was skilled in his profession, an excellent teacher, a ready and perspicuous writer, and a fluent and attractive public speaker. In addition to these qualifications, few men possessed finer social qualities. We condense the following items from the *Industrialist:*

He was born at Kalamazoo, Michigan, July 5th, 1851. He graduated from the Michigan State Agricultural College at the age of 19, and at once entered upon his duties as assistant to his father, the esteemed Professor of Chemistry in the same Institution. The two winters succeeding his graduation were spent at Yale College, in study, under Profs. Johnson and Brush, who testified to his great skill in manipulation and proficiency in his favorite branch—chemistry.

In the summer of 1873, Prof. Kedzie received a call to the chair of Chemistry and Physics, in the Kansas State Agricultural College. Commencing with an almost entire absence of the most ordinary essentials in imparting chemical knowledge—without a course of study, without a lecture-room, and without students even—he succeeded within three years in making chemistry the most attractive study taught in the Institution, and his department, in point of equipment and laboratory conveniences, superior to anything of the kind in the West.

In January, 1874, Professor Kedzie was elected chemist to the State Board of Agriculture, and at once he commenced and carried through a vast amount of work in the line of chemical analysis. All the principal sorts of Kansas soils, minerals, grains, and even fungi, were subjected by him to rigid chemical examination, and the results have been accounted among the most valuable in the records of our State B ard.

In the summer of 1875, the Professor spent four months in Europe, during which time he made a careful examination of the principal laboratories of the Continent and England. The ideas there obtained he was enabled, the following year, to embody in the magnificent laboratory of the Kansas Agricultural College. In July, 1876, he was united in marriage to Miss Ella Gale, of Manhattan, who is left with two small children to mourn his loss. In 1878 he received an urgent call to the chair of Chemistry and Physiology, in Oberlin, Ohio, of which his uncle was president, which he finally accepted, and entered upon the duties of

his new position at the beginning of the college year. His success in that institution was fully commensurate with his ability, and the assiduity with which he pursued his studies doubtless led to the disease of whch he died.

Major Hudson, editor of the *Capital*, says of him:

No young man ever came to Kansas who made more or warmer friends than Prof. Kedzie. Old and young prized his friendship, and admired his brilliant scholarly attainments. It was our privilege to know him well and to honor his many manly traits of character. He was a pure, honorable man in his daily walk, not offensively prudish, but one of the cleanest minded men we have ever known. His idea of honor was chivalric, and his decease is a loss not only to his native state of Michigan, and to his many friends in other states, but to science.

The Lansing (Michigan) *Republican* speaks thus of him:

"During his whole life Prof. Kedzie has been an untiring worker, and although not enjoying good health, has accomplished very much. Even before he graduated, he made a fine collection of birds and birds' eggs which he donated to the college museum. He was the principal originator of the Natural History Society of the Michigan Agricultural College and has done much to make the Society prosperous."

His loss is a calamity not only to his friends, but to his *Alma Mater* and to the college with which he was connected. His chief published writings, so far as we can ascertain, were a work on the Geology of Kansas, and a number of Scientific articles contributed to the Kansas Academy of Science and preserved in its annual reports.

His character was most exemplary in every respect, and his life one to be emulated by all young men.

BOOK NOTICES.

EYESIGHT—GOOD AND BAD. By Robert Brudenell Carter, F.R.C.S. Philadelphia, 1880; Presley Blakiston; $1.50.

This is a comprehensive popular treatise on the exercise and preservation of vision, with numerous illustrations, and is well calculated to educate the public in regard to the construction of the eyes in health, their changes and defects in disease or old age, and the manner of caring for them in infancy and childhood, as well as in later life. The chapters upon Natural and Artificial Illumination and upon Practical hints on Spectacles are especially valuable to those persons who are compelled to use their eyes constantly in writing or upon fine work, and are full of useful information to all.

The author is Ophthalmic Surgeon to St. George's Hospital, London, and has had a vast field of experience in the treatment of diseased and defective eyes, and this little work bears evidence of his entire familiarity with his subject.

XUM

THE SPELL-BOUND FIDDLER. By Kristofer Janson. 12mo., pp. 161; S. C. Griggs & Co., Chicago, 1880; $1.00.

For the past year or two this enterprising firm has been publishing, principally under the editorship of Professor Rasmus B. Anderson, of the University of Wisconsin, a series of books illustrating the literature of the Norse-Land. Among these have been put forth in handsome style The Norse Mythology, The Viking Tales of the North, Echoes from Mist-Land, The Younger Edda, &c.

The Spell-Bound Fiddler is a tale by Kristofer Janson, relating in narrative form the events of the life of the wonderful musician of Norway, Torgeir Audunson, and evidently intended as an effort to break down the puritanism of the country, which fosters a prejudice against all other than church music and presents an obstacle to the progress of the Orphic art among that gifted people.

The introduction, by Prof. Anderson, contains among other interesting facts, some passages in the life of Ole Bull not hitherto published.

SEA AIR AND SEA BATHING. By John H. Packard, M. D. 12mo., pp. 121; Presley Blakiston, Phila., 1880; 50c.

With felicitous appropriateness Health Primer number XI, bearing the above title, makes its appearance, containing just the proper directions upon sea bathing, sea-side resorts, accidents in bathing, sea bathing for invalids, amusements at the sea-shore, cottage life at the sea-shore, sanitary matters, the sea-shore as a winter resort, excursions to the sea-shore, &c. With the mercury in the eighties, as during last week here, such a book will be sought for with avidity and read with profit by all who contemplate summering at the sea-side.

A SERIES OF QUESTIONS IN ENGLISH AND AMERICAN LITERATURE. By Mary F. Hendrick. 12mo., pp. 76; Davis, Bardeen & Co., Syracuse, N. Y., 1880; 35c.

The writer of this little work is Teacher of Reading and English Literature in the State Normal and Training School, Cortland, N. Y., and necessarily brings to the task a large experience. Her object is to present to her pupils the subject of literature in connection with prominent historical epochs and to suggest, by a series of questions, noted authors of each and their best known works; and the volume closes with a list of reference books and a course of reading embracing only the most prominent and standard authors.

Such a book properly studied cannot fail to be of great value to such readers.

REALITIES OF IRISH LIFE. By W. Steuart Trench. Boston, Roberts Brothers, 1880; 12mo., pp. 297; $1.00.

The object of the author seems to be to give a clear and truthful account of the occurrences which violent party spirit or local prejudices have placed before the public distorted, and also to give to the English public, in particular, some idea of the difficulties in the way of progress or improvement in Ireland, as well as to show that in spite of these difficulties such progress and improvement are really practicable. The author writes from the vantage ground of long experience among the people he describes, and his stories bear the marks of truthfulnes and candor.

Among the titles of chapters or tales may be given The Ribbon Code, The Potato Rot, The Revival, The School, The Battle of Magheracloon, &c.

TRANSACTIONS OF THE ACADEMY OF SCIENCE OF ST. LOUIS. Volume IV, No. 1; Octavo, pp. 190; R. P. Studley & Co., St. Louis, 1880; $2.00.

We are indebted to Professor Nipher for the above-named work, which contains two Reports by himself of his Magnetic Observations and Determinations in Missouri; a very interesting article by Judge Nathaniel Holmes, upon The Geological and Geographical Distribution of the Human Race; one by Dr. G. Seyffarth, upon Egyptian Theology, which displays a great familiarity with the language and the history of Ancient Egypt; a very practical paper upon The Improvement of Western Rivers, by C. M. Scott; besides several others worthy of our future perusal.

This Academy is of long standing and has done much good work, especially that of Dr. Engelman and Profs. Nipher and Wadsworth in Meteorology and Physics.

OTHER PUBLICATIONS RECEIVED.

The Report of the Board of Trade of Golden, Colorado, for 1879 and 1880; Learning and Health, by Benjamin Ward Richardson; Davis, Bardeen & Co., Syracuse, N. Y., 15c; "Egyptian Antiquities" found in America, Prof. F. W. Putnam; College Libraries as Aids to Instruction, U. S. Bureau of Education, No. 1, 1880; The Effects of Civilization on the Climate and Rain Supply of Kansas, by H. R. Hilton, Topeka, Kansas; Report on the Interests and Condition of Washington University, St. Louis, Missouri, by W. G. Elliot, President, March, 1880; Report of the State Engineer of California, 1880.

XUM

EDITORIAL NOTES.

THE regular meeting of the Academy of Science was held at its rooms on Tuesday evening, April 27th. A paper upon the Theory of Probabilities, considered from a mathematical standpoint, was read by Professor J. M. Greenwood, which was followed by one from V. W. Coddington, Esq., upon the Construction of School Houses. Both papers were interesting and comprehensive, and received the close attention of the audience. They will probably appear in these columns within a short time.

ON May 21st Rev. Dr. S. S. Laws, President of the University of Missouri, and one of the best thinkers and speakers of the West, will deliver the seventh lecture of the Extra Winter Course before the Kansas City Academy of Science, upon the fruitful subject of "The Categories of Kant."

This subject was proposed by the Kant Club of this city, and all who desire to hear this difficult metaphysical topic discussed in a popular, yet comprehensive and learned manner should by all means be present. Dr. Laws possesses in an unusual degree the power of popularizing and enlivening an abstruse subject, and no one need apprehend a heavy or prosy discourse on this occasion. No charge for admittance.

MRS. MARY F. MUDGE, widow of the late esteemed Professor B. F. Mudge, offers to place at our disposal, for publication in the *Review*, portions of an unfinished work upon which he was engaged at the time of his death, several chapters of which we published last year.

Aside from the associations connected with them, these articles have the merit of accuracy, soundness, vigor and attractiveness of style, and they are in large proportion the result of personal investigation.

PROF. H. S. PRITCHETT, who furnishes an article for this number of the *Review*, has recently resigned the position of Assistant Astronomer at the U. S. Naval Observatory to take permanent charge of the Morrison Observatory at Glasgow, Missouri, in connection with his father, the well-known Professor C. W. Pritchett. Such an accession to the astronomical observers of our state tends to place it in the foreground in this branch of science at least.

A CARD.

The fourth volume of the *Kansas City Review of Science and Industry* commences with this number. My time is so fully occupied with my official duties that I find it impossible to call upon my friends in person, and take this means of asking them to patronize it.

I may say, without boasting, that the *Review* has met with a very flattering reception as the exponent of the scientific and literary culture of the West, but as it is not yet on a paying basis, I am compelled to ask additional aid in maintaining it as a home enterprise, creditable to the community and worthy of a generous support. To those who take no special interest in scientific subjects it is suggested that the articles on Domestic Economy and Hygiene alone are worth more than the subscription price, while those who desire to subscribe for any of the magazines of the country or purchase any kind of miscellaneous or scientific books, can save enough on one or two such transactions, made through my agency, to pay for the *Review* one year.

Sample copies of this number will be sent to some persons who are not subscribers, in the hope that they will become such. Any receiving it who feel that they cannot subscribe will please return it by the carrier.

THEO. S. CASE,
Editor.

DR. G. F. NEEDHAM, Washington, D. C., sends us his Pamphlet (third edition), "Fig Culture at the North," in which he seems to show conclusively, that the people of the Middle and Northern States, by using the proper means, can grow figs of as good quality, and in abundance, at the North, as at the South, that is, as fine as the imported.

WE have received of Dr. A. L. Child, of Plattsmouth, Nebraska, a copy of an elaborate report upon the Progress of the Seasons, Rainfall, Meteorology, &c., of that portion of the state, consisting of observations made and recorded by himself.

REV. S. B. BELL, of this city, has recently commenced the publication of a religious newspaper called the *Mid-Continent Presbyterian*, into which he has introduced the novel feature of printing the communications of skeptics, infidels, and atheists, for reply. It is a liberal move and one which, if managed prudently and skillfully, will be productive of good. Dr. Bell is an earnest and zealous worker, and we wish him a full measure of success.

CAPTAIN HOWGATE is having built at Washington a house, with double walls, windows and roof, for the use of the men to be colonized in the Arctic Regions. It is described as "a long one-story building that looks like a large livery stable, with a shed-like addendum at each gabled end. When finished it is to be taken to pieces, conveyed aboard ship and re-constructed when the home of the polar bear is reached."

THE cranium of Descartes is often adduced as an exception to the general rule that a great mind requires a large brain. This statement seems to have rested on no exact measurement, and Dr. de Bon resolved to test its accuracy. The result is that he finds the cubic capacity of Descartes' skull to be 1,700 centimeters, or 150 centimeters above the mean of Parisian skulls of the present time.

IT is now ascertained that nearly two hundred years ago a Mr. Benjamin Allen discovered and reported to the Royal Society of England that eggs had been found by him in eels, a fact supposed to have been shown only within the past year.

THE Quarterly Report of the Kansas State Board of Agriculture for the first quarter of 1880 is filled with the most useful statistics relative to industries, taxes, values, population, condition of crops, farm animals, meteorology, &c., and shows that in their choice of Major Hudson, as successor to Alfred Gray, for Secretary, the action of the Board was remarkably well taken.

IT is impossible for us to thank each magazine and newspaper separately for kind, encouraging words spoken in regard to the *Review*, so we tender them our thanks *en masse*, and hope to reciprocate on all fitting occasions.

AT the Ministers' Convention, held here last week, Rev. A. C. Williams, of Lincoln, Nebraska, read an essay entitled, Do the Revealments of Science Contradict the Revealments of the Bible? and Rev. C. C. Kimball, of this city, one upon The Influence of Modern Science upon Belief in Miracles, which latter was followed by one upon the same subject by Rev. R. M. Tunnell, of Wyandotte. These papers were ably written, and we hope to present them to our readers soon. Several other papers, more strictly clerical in their character, were read by other ministers.

THE *Boston Journal of Commerce*, which is one of our best commercial exchanges, commenced its fifteenth volume in April. It is edited by Thomas Pray, Jun., under whose management it is rapidly gaining popularity as a reliable price current, an authority on mines and stocks, and a gazette of manufacturing progress and business intelligence.

XUM

PROF. C. W. PRITCHETT of the Morrsion Observatory, at Glasgow, informs us by letter, that he has completed the telegraphic connection between that institution and our Union depot, and is now in readiness to commence sending the time signals mentioned in the *Review* some months since.

THE investigation by Prof. Barker and other experts, of Edison's method of producing and maintaining the electric light at Menlo Park, does not seem to have settled the question in his favor, as, notwithstanging the favorable report, several of our best known electricians still insist that there is nothing new in his experiments, and that the electric light cannot be made practically and economically successful from his standpoint. In this connection, it is quite significant that in the competitive test in London of electric lights, the palm was awarded to the patent of Brush, of Cleveland, Ohio, and the British Government has given an order to the Cleveland Telegraph Supply Company for over $30,000 worth of apparatus, including twenty-four of the largest machines and four hnndred and twenty-four lamps.

Judge E. P. West has just returned from a trip to Marion county, Kansas, where he has been exploring some pre-historic mounds and burial places. He brings some very striking relics, and his report, which will be published in the June *Review*, will be read by archæologists with decided interest.

The *American Naturalist* says that Pierre Lorillard of New York is reported to be preparing to defray the expenses of an exploration and spoliation of the ruins of Mexico and Central America for the benefit and enrichment of some institution in Paris, under the name of the Museé Lorillard. Does not such foreign spoliation come within the purview of Monroe doctrine?

THE Vega, escorted by a large fleet of steamers, arrived at Stockholm April 25th. The city and adjacent coasts for many miles were splendidly illuminated. Prof. Nordenskjold proceeded to the Castle, where they were welcomed by the King and vociferously cheered by the people.

REV. WASHINGTON GLADDEN, who has hitherto had sole charge of the departments, Editor's Table and Literature, in *Good Company*, has relinquished his connection with the magazine, all of which will now be under the supervision of Edward F. Merriam, who has had exclusive management of the Contributor's department. This arrangement begins with Number Eight.

SPECIAL NOTICE.

It seems to have become altogether a fixed thing for T. M. James & Sons, to put their latest importations of rich China and Queensware goods and artistic novelties on exhibition at the opening of each week and upon arrival of new invoices, and the frequency of such receipts affords our citizens many opportunities to examine choice handiwork from abroad and emanating from the most celebrated patterns and embellished by the hands of eminent artists. To-day may be seen in the show windows of T. M. James & Sons a late importation of admirable qualities, and splendid display of hand painted vases of Ionic and Grecian shapes and decorated in the most pleasing manner in landscapes, sporting scenes and classic groups. These goods are very seasonable and their price is very low, considering their elegance, and will repay a close inspection and ought to find a place in a great number of households in our city and suburbs. Messrs. James & Sons are still in almost daily receipt of rich Chinaware elegant Glassware and a great variety of other goods requisite in their large trade. A visit to this great importing house is time profitably spent both in pleasure and economy of prices.